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U.S. Army Center for Health Promotion and Preventive Medicine

PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE M110 FLASH ARTILLERY SIMULATOR

L596

Prepared by:

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and
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USCHPPM

Readiness Thru Health

U.S. Army Center for Health Promotion and Preventive Medicine

The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.

Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.

On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.

The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:

★ *Integrity is the foundation*
★ *Excellence is the standard*
★ *Customer satisfaction is the focus*
★ *Its people are the most valued resource*
★ *Continuous quality improvement is the pathway*

This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.

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14. ABSTRACT
This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the M110 Flash Artillery Simulator during training exercises. The military uses pyrotechnics for signaling, obscuring, and illumination during training exercises to simulate battle conditions. Study results showed no potential for health risks to the hypothetical resident from inhalation of air emissions from the M110. To conduct this study, air emissions from the M110 were collected in a test chamber (Dugway Proving Grounds, UT. This information was then used in an air dispersion model to determine ambient air concentrations at a location 100 meters downwind from the site where the item was activated. Modeled air concentrations were combined with exposure information to estimate the amount of substances the hypothetical resident breathes. This intake was combined with the substance's health information, to determine if there is a potential for health risks from inhjalation of these substances. The health risk included both long-term and short term exposures to the modeled substance concentrations. Study results showed no potential for helath risks from inhalation of air emissions from the M110.

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REPLY TO
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PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE M110 FLASH ARTILLERY SIMULATOR

EXECUTIVE SUMMARY

This assessment looked at the potential for human health effects to offsite residents breathing the air emissions from the M110 flash artillery simulator used during training exercises. The M110 flash artillery simulator is one type of military pyrotechnics that is used to simulate battle conditions. The military uses pyrotechnics for signaling, obscuring, and illuminating during training and combat. Study results showed no potential for health risks to the offsite residents from inhalation of the air emissions from the M110 flash artillery simulator.

To conduct this study, air emissions from the M110 flash artillery simulator were collected in a test chamber (BangBox) at the Dugway Proving Ground, Dugway, Utah. This information was then used in an air dispersion model to determine ambient air concentrations at a location 100 meters (328 feet) downwind from the site where the M110 flash artillery simulator is used. Since the training facility in this study is a hypothetical location, the air model used assumptions that provided conservative estimates of air concentrations.

Modeled air concentrations were combined with exposure information (e.g., number of exposures per year) to estimate the amount of substances the hypothetical resident breathes. This intake was combined with a substance's health information, which was obtained from agencies such as the U.S. Environmental Protection Agency, to determine potential health risks from inhalation of these substances.

The health risk study included both long-term (30 years) and short-term (15 minutes or 1-hour) exposures to modeled substance concentrations. Study results showed no potential for health risks to the hypothetical resident from inhalation of substances released from the M110 flash artillery simulator.

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LIST OF ACRONYMS

AEC	U.S. Army Environmental Center
AEGL	Acute Exposure Guideline Levels
AIHA	American Industrial Hygiene Association
Cr	Chromium
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guidelines
HBSL	Health-Based Screening Level
HCl	Hydrochloric Acid (or Hydrogen Chloride)
mg	Milligram
NAAQS	National Ambient Air Quality Standards
NAC/AEGL	National Advisory Committee for Acute Exposure Guideline Levels
NEW	Net Explosive Weight
OEL	Occupational Exposure Limit
PM_{10}	Particulate Matter Under 10 Micrometers In Size
PRG	Preliminary Remediation Goals
RBC	Risk-Based Concentration
RfC	Reference Concentration
TEEL	Temporary Emergency Exposure Limits
TPCWG	Total Petroleum Criteria Working Group
TSP	Total Suspended Particulates

PYROTECHNICS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-99
RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS
FROM THE M110 FLASH ARTILLERY SIMULATOR

1. PURPOSE

This document presents the evaluation of the potential for human health impacts to offsite residents who may be exposed to combustion products following the use of the M110 flash artillery simulator.

2. AUTHORITY

Memorandum, U.S. Army Environmental Center, 4 June 1999, Subject: Pyrotechnics Risk Assessment.

3. REFERENCES

See Appendix A.

4. BACKGROUND

a. PYROTECHNICS AND THEIR USES.

The term pyrotechnics is derived from the Greek words "pyr" and "technē" meaning fire and art, respectively. This term is often used interchangeably with the term firework. Examples of pyrotechnics include distress flares and fireworks for commercial (e.g., public displays) and consumer (e.g., sparklers) use. Every year, during Independence Day and New Year's Eve, fireworks are used for public displays across the country. During the 1998 Olympic Wintergames in Nagano, Japan, almost 5000 pyrotechnics were launched during a firework display which lasted for 8 minutes.

The military uses pyrotechnics for four purposes: 1) as a method of communication through the use of signals, 2) to produce smoke to reduce enemy effectiveness, 3) for illuminating the field, and 4) to simulate battle conditions during training exercises. Pyrotechnics play an important role in both military training and combat. Therefore, it is important that our troops are adequately trained to use them properly.

b. WHAT IS THE M110 FLASH ARTILLERY SIMULATOR?

Simulators are devices that simulate the sounds and flashes of battle. The M110 flash artillery simulator (M110) is one kind of simulator used to mimic the sounds and flashes of guns; therefore, it is sometimes referred to as "gunflash."

The M110 is about 8 inches long and 2 inches in diameter. It weighs about 0.8 pounds when loaded. To simulate the flashes, the M110 contains a pyrotechnic charge referred to as the flash composition. The flash composition consists mostly of magnesium powder, which is commonly used to produce spark effects, and potassium perchlorate, which is used to stabilize the mixture. The M110 also contains black powder, a propellant charge. Propellant charges are typically used to propel a firework into the air. The M110 black powder mix is composed primarily of potassium nitrate, a common fertilizer, followed by charcoal and sulfur.

c. USES OF THE M110 FLASH ARTILLERY SIMULATOR.

The M110 flash artillery simulator is used during training exercises to imitate the sounds and flashes of incoming artillery during combat. To prepare it for use, the M110 is first filled with gasoline and attached to a squib (an electric igniter) that is connected to an electric source such as a battery or a blasting machine. The M110 is then placed inside a firing tube that is embedded in the ground. For safety purposes, personnel firing the M110 must be located at a safe distance of at least 50 yards and sheltered from flying sparks and splinters (References 1, 2).

d. ASSESSMENT SUMMARY

The general approach can be broken into two major parts: air dispersion modeling and exposure assessment. These are briefly discussed in the paragraphs below. Sections 5 through 7 present a more explicit discussion of the methodology used for this study.

Data generated in the "BangBox" at the Dugway Proving Ground, Utah (Reference 3), were used with an atmospheric dispersion model to estimate the average concentration that would be experienced by an offsite resident. As a conservative distance, it was assumed a person could reside 100 meters from the point of the M110 activation. Since this study is designed to provide results that would be applicable to most Army training facility, the training area used in this evaluation is hypothetical. In addition, air modeling parameters were selected to mimic worst-case conditions.

The exposure assessment included calculating time-averaged concentrations for both long-term (chronic) and acute exposures. For the purpose of this study, air concentrations were averaged over 30 years and 1 hour, for chronic and acute exposures, respectively. Thirty years is the standard EPA default exposure duration for evaluating chronic residential exposures while 1 hour was selected primarily because of the availability of some established acute exposure data. These concentrations were then compared to chronic health-based screening levels established by various EPA regional offices, or short-term reference

concentrations from other sources, depending on the exposure duration (i.e. 30 years versus 1 hour).

5. METHODS AND DATA COLLECTION.

a. EMISSION FACTORS

The air modeling emission rates were derived from the pyrotechnics emission studies conducted at Dugway Proving Ground, Utah (Reference 3). These studies sampled air emissions from the firing of weapons and/or munitions used in training. The purpose of this sampling was to identify and quantify air emissions. The data provided by Dugway Proving Ground included the identification of the munitions item and compounds sampled, net explosive weight (NEW) of item, and compound emission factors. Emissions data from this study are included in the first four columns of the air dispersion modeling output data in Appendix B.

b. AIR MODEL

(1) BACKGROUND

Air dispersion models are available to mathematically simulate atmospheric conditions and behavior to predict downwind concentrations caused by emissions from various sources. However, specific models are not available to estimate the dispersion of emissions from the use of munitions in training. The emissions from munitions used in training result in ambient concentrations of compounds at various locations. The magnitude and location of these concentrations depend on many factors including the amount and type of emissions, the behavior of the source, and meteorological conditions. Based on the evaluation of air dispersion models for military munitions, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) recommended using the Integrated PUFF (INPUFF) Model to estimate the dispersion of emissions from pyrotechnics (Reference 4).

(2) MODEL SELECTION

The INPUFF Model (Reference 5) was developed to simulate dispersion from instantaneous or semi-continuous point sources. This Gaussian-integrated puff model is capable of addressing a puff type release over short periods of time, and computations can be performed for a single point source for multiple receptors. The algorithm used to calculate concentrations uses a vertically uniformed wind direction (with no chemical reaction) to compute the contribution of each puff at a receptor for each time step/interval.

(3) ASSUMPTIONS

Some assumptions were made to best represent the M110 in the model. These assumptions were as follows:

(a) For unconventional sources with no physical stack dimensions, the initial horizontal and vertical dispersion values (σ_y and σ_z) of the released puff were used to define the dimensions of the puff. Therefore, plume rise and formation were not determined by characterizing flue gas exit velocity and stack diameter, as they are with conventional point sources. The initial dimensions were set to values measured during Dugway Proving Ground testing and the dispersion of the initial cloud was modeled. The physical dimensions, including height and length of the puff or cloud, were estimated from the thermograph data recorded at every time step. The data also included minimum, mean, and maximum temperature readings during the duration of the emission test and were used to define the flue gas exit temperature.

(b) The worst-case release scenario analysis was performed using EPA Risk Management Program Guidance (Reference 6). This guidance includes tables for estimating the footprint of chemical releases. These guidelines were intended to inform emergency responders of the worst possible accidental release, but not necessarily the most likely. The EPA has defined most default conditions for meteorological modeling parameters. Table 1 lists the parameters that were used in the model.

(c) The resident used in this study was assumed to be directly downwind from the source. The meander of the puff is a major factor when estimating concentrations at given locations downwind from the source. Assuming that the resident is directly downwind from the source is the same as assuming that there is no puff meander and provides the most conservative modeled concentrations.

(d) Emissions were assumed to be emitted from a single representative source. This method is more conservative than the assumption that several individual sources are emitted over an area. The EPA guidance document "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources" (Reference 7) recommends merging parameters for multiple sources that are within 100 meters of each other. For the purpose of this study, an event was defined as the activation of five items at one time.

TABLE 1: AIR MODEL INPUT PARAMETERS

MODEL PARAMETERS	
Number of meteorological periods (NTIME)	1
Duration of each meteorological period (ITIME)	200 s
Number of updates to the source (NSRCDS)	100
Duration/time step between each source update (ISUPDT)	2 s
Total time modeled/Simulation Period (NTIME * ITIME) (NTIME * ITIME = NSRCDS * ISUPDT)	200 s
SOURCE PARAMETERS	
Source/Stack Diameter	0.12 m
Source/Stack Height	2.13 m
Source Exit Temperature	342.75 degrees Kelvin (^{o}K) (or 158 ^{o}F)
Exit Velocity	NA
Emission Rate	UNIT EMISSION RATE OF 1 g/s
Initial horizontal dispersion (σ_y)	0.72 M
Initial vertical dispersion (σ_z)	0.74 M
WORST CASE METEOROLOGICAL PARAMETERS	
Wind Speed	1 m/s
Atmospheric Stability	Category F
Wind Direction	270°
Ambient Temperature	293 degrees Kelvin (^{o}K) (or 68 ^{o}F)
Worst case Receptor Location	100 m directly downwind

(4) GENERAL METHODOLOGY

(a) The INPUFF model determined the amount of time it would take for the puff to pass over a location 100 meters (m) downwind. The released puff migrated at a constant wind speed of one meter per second (1 m/s) downwind from the point of activation. Assuming a distance of 100 m and a travel velocity of 1 m/s, it took 100 s for the center of each puff to reach this distance.

(b) The model was run for a total calculation time of 200 s to ensure that the total mass of the puff had passed the 100 m location and the source behavior recorded in the thermograph data was sufficiently simulated. Since the model is capable of providing 100 updates (puffs), the initial puff was assumed to

have a time length of 200 s divided by 100 updates (or the puff lasted 2 s). Calculated concentrations every time step (2 s) indicated that the puffs reached the receptor within 70 s and dissipated below the lowest concentration the model could calculate in this instance (1×10^{-12} g/m^3) within 162 s.

(5) USE OF MODEL OUTPUT

The concentrations provided by the INPUFF model were based on a unit emission rate of 1 g/s from an emission source and did not represent any pollutant-specific concentrations from the use of pyrotechnics. The relationship between the emission rate and predicted concentration is linear. Therefore, the ratio of the predicted concentration to the unit emission rate was multiplied by each pollutant-specific emission rate to provide pollutant-specific concentrations.

(6) DETERMINATION OF POLLUTANT-SPECIFIC EMISSION RATES

(a) The actual pollutant emission rate per item (ER_1) for each pollutant was calculated using the following equation:

$$ER_1 = \frac{M \cdot CV}{t} \qquad \text{Equation 1}$$

where:

ER_1 = emission rate for one item (g/(item*sec))
M = total mass (lb) of pollutant emitted per item (lb/item)
CV = conversion factor (453.59 g/lb)
t = release duration in seconds as obtained from the training manual (s) (References 1 and 8)

Example 1
Sample Calculation Using Equation 1*:

$$ER_1 = \frac{(5.082E-02)(453.59)}{2}$$

= 1.151E+01 g/(s*item)

* Calculation for TSP. Averaged adjusted emission factor of total suspended solids (TSP) in lb/item was obtained from Appendix B.

(b) The pollutant emission rate for an event (ER_{EV}) for each pollutant was calculated using the estimated number of potential items used in a training event according to the following equation:

$$ER_{EV} = ER_1 \cdot I \qquad \text{Equation 2}$$

where:

ER_{EV} = emission rate for the estimated number of potential items used in a training event (g/s)
ER_1 = emission rate for one item (g/(item*sec))
I = items per event (item/event)

Example 2
Sample Calculation Using Equation 2*:

$ER_{EV} = (1.151E+01)(5)$

= 5.763E+01 g/s

* Calculation for TSP

(c) Pollutant-specific ambient concentrations for an event (CONC) were calculated using the following equation:

$$CONC = ER_{EV} \cdot \frac{UC}{ER_{unit}} \qquad \text{Equation 3}$$

where:

CONC = pollutant concentration based on the number of items used in a training event (g/m^3)
ER_{EV} = emission rate for the estimated number of items used in a training event (g/s)
ER_{unit} = unit emission rate as used in the model (g/sec)
UC = concentration based on the unit emission rate (g/m^3)

Example 3
Sample Calculation Using Equation 3*:

$$CONC = (5.763E+01)\frac{(1.026E-04)}{(1)}$$

$$= 5.913E\text{-}03\ g/m^3$$

* Calculation for TSP

c. EXPOSURE ASSESSMENT

(1) EXPOSURE ASSUMPTIONS

(a) Exposure assumptions were selected using a typical use scenario for the M110. This use scenario was developed based on consultation with the U.S. Army Environmental Center's (AEC) senior training advisor (References 9,10). The frequency of use of the M110 was required to determine how much substance an off-post resident will be exposed to in the time period of interest (i.e., acute or chronic exposure). For the purposes of this study, a training scenario is defined as a day or session of training whereas a training event is defined as a single use of pyrotechnics. A training scenario may consist of multiple training events. Table 2 summarizes the specific assumptions used to determine how often the M110 is used during a training scenario.

TABLE 2: FREQUENCY OF USE FOR THE M110

Parameter	Value Used
Number of items used per training scenario	10
Time between events	5 in 1 hour 5 more 3 hours later
Number of training events per day the M110 is used	2
Number of days per year (scenario) the M110 is used	5

(b) In order to conservatively estimate emissions, it was assumed that five M110s were activated at the same time. The puff that resulted from this event was modeled to a point 100 meters downwind. Since the unit emission rate was calculated using a runtime of 200 seconds, each event was also assumed to last 200 seconds (or 3.33 minutes).

(2) TIME-AVERAGING

For the chronic assessment, time-averaged concentrations were calculated using EPA's default residential exposure period of 30 years (this value assumes that the resident spends 30 years at the same residence). This was done to derive concentrations that would be consistent with the exposure duration used by the EPA so that estimated substance concentrations could be compared to their respective health-based screening levels.

In this evaluation, training scenarios occur approximately five times a year (References 9, 10). Using the default residence time established by the EPA, the assumption was made that someone could be exposed to five training scenarios per year for 30 years.

(a) The average daily concentrations were calculated using Equation 4. An example calculation using TSP is shown in Example 4. It should be noted that the average modeled concentration was converted from g/m^3 to $\mu g/m^3$ before it was used in Equation 4.

$$C_d = \frac{CONC \cdot ET \cdot EF_{day}}{1440} \qquad \text{Equation 4}$$

where:

C_d	= the average daily concentration ($\mu g/m^3$)
CONC	= average modeled concentration ($\mu g/m^3$)
ET	= exposure time (minutes/event)
EF_{day}	= number of events per day (events/day)
1440	= unit conversion from minutes to day

Example 4
Sample Calculation Using Equation 4:

$$C_{d(TSP)} = \frac{(5.913E+03)(3.333)(2)}{1440}$$

$$= 2.74E+01 \ \mu g/m^3$$

Averaged modeled concentration of total suspended solids (TSP) was obtained from Appendix B. The exposure parameters were obtained from Table 3.

(b) The average chronic concentrations were calculated using Equation 5. The resulting concentration (C_d) from Equation 4 was used in Equation 5 to determine the average chronic concentration. Example 5 shows how this calculation was performed.

$$C_{chronic} = \frac{C_d \cdot EF_{years} \cdot ED}{AT} \qquad \text{Equation 5}$$

where:

$C_{chronic}$ = average chronic concentration (µg/m^3)
C_d = average daily concentration (µg/m^3)
EF_{years} = number of days per year (days/year)
ED = exposure duration (yr)
AT = averaging time (days)
(for carcinogenic endpoint, AT = 70 years x 365 days;
noncarcinogenic endpoint, AT = ED x 365 days)

Example 5
Sample Calculation Using Equation 5:

$$C_{chronic(TSP)} = \frac{(2.74\,E+01)(5)(30)}{(30)(365)}$$

= 3.75E-01 µg/m^3

Averaged modeled concentration was calculated as shown in Example 4. The exposure parameters were obtained from Table 3.

(c) This study assumed that the same person would be exposed 5 days every year for 30 years. Since the air model was run for five items and ten items could potentially be used per training day (See Table 2), two training events (EF_{day}) were characterized per day. Table 3 lists the exposure parameters used in Equations 4 and 5.

TABLE 3: EXPOSURE PARAMETERS USED TO DETERMINE TIME-AVERAGED CHRONIC AIR CONCENTRATIONS

Exposure Parameter	Value Used
Exposure Time (ET)	3.333 minutes/event
Exposure Frequency (EF_{day})	2 events/day
Exposure Frequency (EF_{year})	5 days/year
Exposure duration (ED), years	30 years

(d) Unlike the chronic evaluation, no clear guidance for evaluating acute exposures is currently available. Due to the nature of the use of pyrotechnics and the short duration of the concentration plume, however, acute exposures cannot be overlooked. For the purpose of this study, acute is defined as a 1-hour exposure. This is so that the estimated concentrations can be compared with guidelines developed specifically for emergency planning purposes (see discussion on acute toxicity below). This is a conservative assumption since the air model showed that the receptor is not expected to be exposed to more than 4 minutes of the concentration plume following activation of five M110s.

(e) The average acute concentrations were computed using Equation 6. The exposure frequency is based on the number of events per hour or 15 minutes. Example 6 contains a sample calculation of this equation. Since TSP has no acute toxicity value, an acute concentration was not determined for this substance. Therefore, hydrochloric acid (HCl) was used for the example calculation.

$$C_{acute} = \frac{CONC \cdot ET \cdot EF_{hour}}{60} \qquad \text{Equation 6}$$

where:

C_{acute} = acute concentration ($\mu g/m^3$)
CONC= average modeled concentration ($\mu g/m^3$)
ET = exposure time (minutes/event)
EF_{hour} = exposure frequency (events/hour)
60 = unit conversion, 60 minutes/hour

Example 6
Sample Calculation Using Equation 6:

$$C_{acute(HCl)} = \frac{(1.63E+01)(3.333)(1/0.25)}{60}$$

$$= 3.62\ \mu g/m^3$$

The average acute concentration (CONC) was obtained from Appendix B. For HCl, the acute toxicity value is based on a 15-minute exposure (TEEL-1). Therefore, the acute concentration was adjusted so that C_{acute} can be compared with its toxicity value.

d. TOXICITY ASSESSMENT

The potential for health risks was determined by comparing time-averaged air concentrations to health-based screening levels which are typically developed from a substance's known toxicity. These toxicity values typically include different levels of safety factors depending on the level of confidence of the critical study. Appendix C contains a table of the screening values for both the chronic and the acute evaluations.

If the time-averaged air concentrations are below these screening levels, they are considered safe for everyone, including sensitive people such as the sick, elderly, and children. If the average modeled concentrations are greater than these screening levels, further analysis is warranted. It should be noted that concentrations greater than the screening levels do not indicate an onset of health effects, but rather the potential for such.

(1) CHRONIC ASSESSMENT

(a) The chronic assessment was evaluated using a screening approach. Using this method, a substance's estimated average concentration was compared to its health-based screening level. If this ratio was less than 1, no further analysis was required. The screening approach is conservative because the exposure assumptions used by the EPA assume that the resident is exposed for 350 days per year (this assumes 2 weeks of vacation per year). Since the training event in which the M110 will be used is not expected to exceed 5 days per year, health-based levels specific to this study may be higher.

(b) Health-based screening levels were obtained from the EPA, primarily Region 3 and Region 9 (References 11, 12). The Internet sites of both regions were checked to ensure that the most recent information was used Although the general approach used by both offices is the same, the exposure assumptions differ enough so that final recommended screening levels can

vary to a certain degree. In both methods, a substance's health-based concentration is selected using the toxicity endpoint that derives a lower concentration. For example, if a substance has known systemic toxicity and is a carcinogen, concentrations were calculated using both toxicity information. The lower concentration was then chosen as the recommended screening level to maintain a conservative approach.

(c) A hierarchy was developed in order to quantitatively evaluate for as many of the identified substances as possible. Since the methodology used by Region 9 results in lower health-based screening levels than Region 3, the Region 9 preliminary remediation goals (PRGs) were used first. Region 3's risk-based concentrations (RBCs) were used only when a substance's PRG was not available. The only exception was for chromium(VI) [Cr(VI)] where Region 9 used a carcinogenic toxicity value that was seven times greater than EPA's recommended value (Reference 13) to develop its screening level for inhalation exposure. Since the EPA does not advocate the application of this multiplication factor, the RBC for Cr(VI) was used instead of the PRG.

(d) Some substances have neither PRGs nor RBCs because they have their own set of regulatory standards. Under the Clean Air Act, the EPA is required to set National Ambient Air Quality Standards (NAAQS) (Reference 14) for several substances considered harmful to public health and the environment. Currently, NAAQS are available for six substances, of which carbon monoxide, nitrogen dioxide, lead, sulfur dioxide and particulate < 10 micrometers (PM_{10}) have been detected in the M110 Bang Box study. The NAAQS for the longer averaging time were used for the chronic evaluation. Depending on the substance, this can range from an 8-hour average to an annual average. In addition, since the majority of the measured total suspended particulates (TSP) were PM_{10} (Reference 3), the NAAQS for PM_{10} was used to evaluate potential health effects from exposure to TSP.

Example 7
Sample Calculation of Comparing a Substance's Estimated Chronic Concentration to Its Health-Based Screening Level:

$$\frac{C_{chronic(TSP)}}{HBSL} = \frac{3.75E-01}{5.0E+01}$$

= 7.50E-03 (or 0.008)

Note that HBSL is the health-based screening level of TSP. For TSP, the HBSL is based on the NAAQS. In this case, the resulting ratio is three orders of magnitude less than 1.

(e) Many petroleum hydrocarbons were detected but do not have specific screening levels. Therefore, the approach recommended by the Total Petroleum Criteria Working Group (Reference 15) was adopted to evaluate petroleum hydrocarbon mixtures. Based on the working group's assessment of various hydrocarbons, they recommended that mixtures be separated according to a substance's number of carbons and its chemical class (i.e., aliphatic or aromatic[1]). Generally, as a substance's carbon number increases, its molecular weight increases and it is, therefore, not a substance of concern via inhalation. The working group has also concluded that aromatic hydrocarbons tend to be more toxic than aliphatic hydrocarbons (Reference 15).

(f) Table 4 tabulates the inhalation toxicity values used to evaluate exposure to petroleum mixtures. To be consistent with the methodology used in this study, the reference concentrations (RfCs) were converted to PRGs using Region 9 assumptions. The resulting PRGs are shown in Table D-4.

TABLE 4: SUMMARY OF RfCs USED FOR PETROLEUM HYDROCARBONS (Reference 15)

Carbon Range	Aromatic Inhalation RfC (mg/m^3)	Aliphatic Inhalation RfC (mg/m^3)
$C_5 - C_6$ $C_{>6} - C_8$		18.4
$C_{>7} - C_8$	0.4	
$C_{>8} - C_{10}$ $C_{>10} - C_{12}$ $C_{>12} - C_{16}$	0.2	1.0
$C_{>16} - C_{21}$ $C_{>21} - C_{35}$	NA	NA
NA = not applicable for high molecular weight TPHs ($C_{>16}$) because compounds in this carbon range are not volatile and therefore, inhalation is not a pathway of concern.		

(2) ACUTE ASSESSMENT

(a) As indicated previously, no acceptable method for assessing acute health impacts is currently available. It was not until recently that EPA guidance has addressed the need to evaluate acute health effects from inhalation (Reference 17). Even then, acute toxicity data for risk assessment purposes were not readily available. The EPA recognized this deficiency and spearheaded the National Advisory Committee for Acute Exposure Guideline

[1] Aliphatic hydrocarbons are hydrocarbons in which the carbon atoms are joined by single covalent bonds consisting of two shared electrons (e.g., butane). Aromatic hydrocarbons have ring structures (e.g., benzene). Source: Reference 16

Levels for Hazardous Substances (NAC/AEGL Committee). However, to date, AEGLs are only available for a handful of substances.

(b) To circumvent this problem, several state regulatory agencies have suggested that guidelines developed for emergency purposes be used in the interim. Although there have been suggestions to use occupational exposure limits (OELs) by applying additional safety factors (References 18, 19), OELs were not used in this study because they introduce even more uncertainty than the use of emergency guidelines. More uncertainty is introduced because OELs are designed to protect the workplace environment and assume 8 hours a day, 5 days a week exposures. By definition, these exposures are more chronic than acute.

(c) Emergency planning guidelines on the other hand, are more appropriate because they are typically developed for 1-hour exposures or less. In addition, safety factors may also have been included so that the values are protective of the general population.

(d) Emergency Response Planning Guidelines (ERPG) published by the American Industrial Hygiene Association (AIHA) (Reference 20) and the Temporary Emergency Exposure Limits (TEELs) developed by the Department of Energy (DOE) (Reference 21) were also used for this study, specifically the ERPG-1s and the TEEL-1s. Since TEEL-1s are intended for 15-minute exposures, air concentrations compared to TEELs were averaged over a 15-minute period as opposed to 1-hour in this assessment. This would not underestimate acute exposures to M110 emissions because the concentration plume is not expected to last more than 4 minutes. The ERPG-1 and TEEL-1 are both similarly defined. The AIHA defines ERPG-1 as follows.

"The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

The DOE defines the TEEL-1s as follows:

"The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

(e) For this study, ERPGs were preferred over the TEELs because they are more vigorously reviewed before they are published, whereas the TEELs are not. Example 8 shows a sample calculation of how a substance's estimated acute concentration is compared to its acute toxicity value.

Example 8
Sample Calculation of Comparing a Substance's Estimated Acute Concentration to Its Acute Toxicity Value:

$$\frac{C_{acute(HCl)}}{ATV} = \frac{3.62E+00}{7.14E+03}$$

= 5.07E-04 (or 0.0005)

Note that ATV is the acute toxicity value of HCl. In this case, the resulting ratio is four orders of magnitude less than 1.

6. RISK CHARACTERIZATION

Appendix D presents the results from the M110 risk characterization. Note that for some substances, two concentrations were reported because of different analytical test methods. In those instances, the higher concentration was used.

a. CHRONIC HEALTH RISK

The outcome indicated that no chronic health risks are expected from breathing the air emissions from the M110. Since all ratios were below one, no further evaluation was needed. The highest ratio of 0.157 (or 0.16) was estimated for chromium which shows that the estimated chromium concentration is still well below its health-based screening level.

b. ACUTE HEALTH RISK

For the acute analysis, all ratios were below one, indicating there is no potential for acute health risks. The highest ratio from the comparison of the averaged acute concentration to a substance's acute toxicity value was 0.05 for barium. This low ratio indicates that the estimated acute concentration of barium is well below its acute toxicity value.

c. SUBSTANCES WITH NO TOXICITY DATA

Some substances were not quantitatively evaluated because they do not have established toxicity data. Comparing the concentrations of these substances to similar compounds with available toxicity data, it may be concluded that no

potential for health effects would be expected from inhalation of these substances.

d. FACT SHEET

A copy of the fact sheet submitted to AEC is included in Appendix E. The fact sheet uses the results from this study to summarize health concerns related to inhalation of the air emissions from the M110.

7. UNCERTAINTY DISCUSSION

The limitations inherent in modeling and the added conservatism of the evaluation contribute to the uncertainty of the study results. In addition, the risk assessment methodology typically may include safety factors that are embedded in the toxicity data to ensure adequate protection of the general population, particularly, susceptible individuals such as children, the sick, and the elderly. Table 5 identifies various areas of uncertainty related to this assessment.

TABLE 5: TYPES OF UNCERTAINTY

Issue	Uncertainty	Direction of Effect
Modeling		
Modeled versus real-time sampling	The air concentrations in this study were modeled. Actual air concentrations taken from the field may be higher or lower.	Varies
Hypothetical resident assumed to be located directly downwind	Unless the area around the training facility is populated, the chances that a person living directly downwind is low.	Overestimates
Frequency of use for the M110	Actual frequency of use of M110s during a training event may be different from those stated in this report.	Varies
Assumption that five M110s are activated simultaneously	Although the M110s may be activated within minutes of one another, the chances that five M110s are activated all at once and from the same location is highly unlikely.	Overestimates
Using worst-case meteorological conditions	To ensure that this study may be applicable to all training areas, worst-case meteorological conditions were used in the air model runs.	Overestimates

Issue	Uncertainty	Direction of Effect
Exposure Assessment		
Estimating time-averaged concentrations	Actual exposure from the M110 is intermittent. If one were to plot a person's exposure profile, the plot would consist of a series of spikes. Since current risk assessment methodology does not allow the evaluation of potential health risks as a function of time, a single concentration, averaged over the exposure duration was used. In this study, the exposure durations used were 30 years and 1-hour.	Varies
Chromium speciation	All chromium was assumed to be Cr(VI) which is more toxic than Cr(III).	Overestimates
Comparing estimated concentrations to established screening levels	The Region 3 and Region 9 health-based screening levels were developed using different exposure assumptions from those in this study. In this case, these assumptions resulted in more conservative screening levels.	Overestimates
Screening assessment versus calculating an average daily intake	Calculating an average daily intake allows the use of scenario-specific assumptions. However, unless the ratio of concentration to screening level approaches one, a screening assessment is useful as a first-cut evaluation.	Varies
Exposure to other munitions	Other munitions are typically used during the same training event. These items may contain substances that are similar or different from those detected in the M110.	Underestimates
Toxicity Assessment		
Lack of toxicity data	Some substances were not quantitatively evaluated because they have no known toxicity data.	Underestimates
Modifying and uncertainty factors for toxicity data	Modifying factors and uncertainty factors of varying degree are typically applied to toxicological values. These factors are used to account for different conditions such as extrapolating from animal studies for human health evaluation.	Overestimates

8. CONCLUSION

This study showed that residents who live as close as 100 meters directly downwind from the training facility are safe from inhalation of the air emissions from the M110. It is believed that the assumptions contained in this analysis are conservative enough to be protective of all the population including the sick, elderly, and children.

9. RECOMMENDATIONS

Since the results from this study are intended for a hypothetical training facility, they can vary depending on site-specific conditions. However, because of the conservative assumptions used (e.g., worst-case meteorological conditions) it is believed that most site-specific analyses would result in even lower concentrations. Therefore, the results from this evaluation should be applicable to most training facilities unless site-specific conditions vary significantly.

10. POINT OF CONTACT

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APPENDIX A

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APPENDIX B

AIR DISPERSION MODELING OUTPUT DATA

Table B-1: Air Modeling Output Data for Metals, Particulates, and Miscellaneous Compounds

	Simulator Flash Artillery M110 Average NEW, lb = 0 19 Average Number of Items = 1				Items per event (I): release duration (t): Unit Concentration (UC):	5 items/hour 2 seconds 1.026E-04 g/m^3		
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items (grams/m^3) CONC	Pollutant Emission Rate (g/sec)/item ER_1	* Event Pollutant Emission Rate 5 Items (g/sec) ER_{EV}
Particulate								
TSP	1.939E+01	NM (d)	2.711E-01	5.082E-02	2.305E+01	**5.913E-03**	1.153E+01	5.763E+01
PM_{10}	3.188E+01	1.793E-02	4.007E-01	7.513E-02	3.408E+01	**8.741E-03**	1.704E+01	8.520E+01
HCl/Cl_2								
HCl (a)	5.294E-02	ND	7.463E-04	1.399E-04	6.347E-02	**1.628E-05**	3.173E-02	1.587E-01
Cl_2 (a)	2.276E-02	3.231E-03	2.733E-04	5.124E-05	2.324E-02	**5.961E-06**	1.162E-02	5.810E-02
Dioxin/Furan								
Dioxin TEQ (b)	3.417E-10	1.371E-10	6.954E-12	1.304E-12	5.914E-10	**1.517E-13**	2.957E-10	1.479E-09
CEM System								
Carbon Monoxide (CO)	2.524E+00	1.385E-01	3.344E-02	6.270E-03	2.844E+00	**7.295E-04**	1.422E+00	7.110E+00
Nitrogen Oxide (NOx)	7.375E-01	4.064E-02	9.685E-03	1.816E-03	8.237E-01	**2.113E-04**	4.118E-01	2.059E+00
HCl (a)	-1.295E-01	NM (d)	1.327E-04	2.488E-05	1.128E-02	**2.894E-06**	5.642E-03	2.821E-02
Carbon Dioxide (CO_2)	7.726E+02	6.822E+02	1.275E+00	2.391E-01	1 085E+02	**2.782E-02**	5.423E+01	2.711E+02
Sulfur Dioxide (SO_2)	5.554E-02	1.833E-04	7.763E-04	1.455E-04	6.602E-02	**1.693E-05**	3.301E-02	1.650E-01
Particulate-phase Metals								
Aluminum	1.076E-01	NM (c)	1.506E-03	2.824E-04	1.281E-01	**3.285E-05**	6.404E-02	3.202E-01
Antimony	1.515E-02	NM (c)	2.134E-04	4.002E-05	1.815E-02	**4.656E-06**	9.076E-03	4.538E-02
Arsenic	ND	NM (c)	ND	ND	ND	ND	ND	ND
Barium	1.168E+00	NM (c)	1.630E-02	3.057E-03	1.387E+00	**3.556E-04**	6.933E-01	3.466E+00
Beryllium	ND	NM (c)	ND	ND	ND	ND	ND	ND
Cadmium	1.056E-04	NM (c)	1.463E-06	2.744E-07	1.245E-04	**3.192E-08**	6.223E-05	3.111E-04
Chromium	2.906E-03	NM (c)	4.052E-05	7.598E-06	3.446E-03	**8.840E-07**	1.723E-03	8.616E-03
Cobalt	3.293E-04	NM (c)	4.594E-06	8.613E-07	3.907E-04	**1.002E-07**	1.953E-04	9.767E-04
Copper	2.591E-02	NM (c)	3.620E-04	6.788E-05	3.079E-02	**7.898E-06**	1.540E-02	7.698E-02
Lead	3.693E-03	NM (c)	5.158E-05	9.672E-06	4.387E-03	**1.125E-06**	2.194E-03	1.097E-02
Magnesium	5.400E+00	NM (c)	7.597E-02	1.424E-02	6.461E+00	**1.657E-03**	3.230E+00	1.615E+01
Manganese	4.337E-03	NM (c)	6.042E-05	1.133E-05	5.139E-03	**1.318E-06**	2.569E-03	1.285E-02
Nickel	1.768E-04	NM (c)	2.455E-06	4.603E-07	2.088E-04	**5.355E-08**	1.044E-04	5.219E-04
Phosphorus	2.107E-03	NM (c)	2.926E-05	5.486E-06	2.488E-03	**6.383E-07**	1.244E-03	6.221E-03
Selenium	ND	NM (c)	ND	ND	ND	ND	ND	ND
Silver	ND	NM (c)	ND	ND	ND	ND	ND	ND
Thallium	ND	NM (c)	ND	ND	ND	ND	ND	ND
Zinc	5.827E-03	NM (c)	8.108E-05	1.520E-05	6.896E-03	**1.769E-06**	3.448E-03	1.724E-02
Mercury	ND	NM (c)	ND	ND	ND	ND	ND	ND

Footnotes:
ND = Not Detected.
NEW = Net Explosive Weight
NM = Not Measureable
a: HCl/Cl_2 levels were too low to be reliably measured
b: Presence questionable - reported at similar levels in samples and blanks
c: Insufficient material to analyze.
d: Concentration reported was less than zero.

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

	Simulator Flash Artillery M110 Average NEW, lb = 0.19 Average Number of Items = 1				Items per event (I): release duration (t): Unit Concentration (UC):	5 items/hour 2 seconds 1.026E-04 g/m^3		
Compound (a)	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/item ER_i	* Event Pollutant Emission Rate 5 Items (g/sec) ER_{EV}
Total Nonmethane Hydrocarbons (TNMHC)								
TNMHC	2.267E+00	1.760E-01	2.598E-02	4.871E-03	2.210E+00	**5.668E-04**	1.105E+00	5.524E+00
Volatile Organic Compounds (VOCs)								
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	6.602E-04	8.291E-04	ND	ND	ND	**ND**	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2,4-Trimethylbenzene	6.724E-01	1.519E-02	8.161E-03	1.530E-03	6.940E-01	**1.780E-04**	3.470E-01	1.735E+00
1,2,4-Trimethylbenzene & sec-Butylbenzene	8.480E-02	1.570E-02	8.587E-04	1.610E-04	7.303E-02	**1.873E-05**	3.652E-02	1.826E-01
1,2-Dibromoethane	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2-Dichloroethene	ND	ND	ND	ND	ND	**ND**	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	**ND**	ND	ND
1,3,5-Trimethylbenzene	3.405E-02	5.000E-03	3.609E-04	6.767E-05	3.070E-02	**7.874E-06**	1.535E-02	7.674E-02
1,3,5-Trimethylbenzene	3.430E-01	7.637E-03	4.212E-03	7.898E-04	3.583E-01	**9.189E-05**	1.791E-01	8.957E-01
1,3-Butadiene	1.850E-03	ND	2.296E-05	4.304E-06	1.952E-03	**5.008E-07**	9.762E-04	4.881E-03
1,3-Butadiene	1.882E-02	ND	2.335E-04	4.378E-05	1.986E-02	**5.093E-06**	9.929E-03	4.964E-02
1,4-Dioxane	ND	ND	ND	ND	ND	**ND**	ND	ND
1-Butanol	ND	ND	ND	ND	ND	**ND**	ND	ND
1-Butene	2.300E-03	1.000E-04	2.791E-05	5.234E-06	2.374E-03	**6.089E-07**	1.187E-03	5.935E-03
1-Hexene	4.000E-04	ND	4.978E-06	9.335E-07	4.234E-04	**1.086E-07**	2.117E-04	1.059E-03
1-Hydroxy-2-propanone	ND	ND	ND	ND	ND	**ND**	ND	ND
1-Methylnaphthalene	ND	1.102E-03	ND	ND	ND	**ND**	ND	ND
1-Pentene	8.000E-04	ND	9.924E-06	1.861E-06	8.440E-04	**2.165E-07**	4.220E-04	2.110E-03
1-Propanol	ND	ND	ND	ND	ND	**ND**	ND	ND
2,2,4-Trimethylhexane	2.100E-03	5.500E-04	1.924E-05	3.608E-06	1.637E-03	**4.198E-07**	8.183E-04	4.091E-03
2,2,4-Trimethylpentane	1.630E-02	2.150E-03	1.759E-04	3.297E-05	1.496E-02	**3.836E-06**	7.478E-03	3.739E-02
2,2-Dimethylbutane	7.400E-03	1.500E-04	9.009E-05	1.689E-05	7.662E-03	**1.965E-06**	3.831E-03	1.916E-02
2,2-Dimethylheptane	ND	ND	ND	ND	ND	**ND**	ND	ND
2,2-Dimethylpropane	ND	ND	ND	ND	ND	**ND**	ND	ND
2,3,4-Trimethylpentane	2.950E-03	5.000E-04	3.043E-05	5.706E-06	2.588E-03	**6.639E-07**	1.294E-03	6.470E-03
2,3-Butanedione	ND	ND	ND	ND	ND	**ND**	ND	ND
2,3-Dihydro-1-methyl-1H-indene	4.698E-02	3.747E-03	5.599E-04	1.050E-04	4.762E-02	**1.221E-05**	2.381E-02	1.190E-01
2,3-Dihydro-4-methyl-1H-indene	5.934E-02	4.893E-03	7.063E-04	1.324E-04	6.007E-02	**1.541E-05**	3.004E-02	1.502E-01
2,3-Dimethylbutane	1.660E-02	4.500E-04	2.007E-04	3.763E-05	1.707E-02	**4.378E-06**	8.534E-03	4.267E-02

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound (a)	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/item ER_i	* Event Pollutant Emission Rate 5 Items (g/sec) ER_{EV}
2,3-Dimethylhexane	4.650E-03	3.500E-04	5.342E-05	1.002E-05	4.543E-03	**1.165E-06**	2.271E-03	1.136E-02
2,3-Dimethylpentane	1.705E-02	1.550E-03	1.927E-04	3.613E-05	1.639E-02	**4.203E-06**	8.193E-03	4.097E-02
2,4,4-Trimethyl-1-pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
2,4,4-Trimethyl-2-pentene	ND	ND	ND	ND	ND	**ND**	ND	ND
2,4-Dimethylhexane	9.100E-03	4.500E-04	1.075E-04	2.015E-05	9.139E-03	**2.344E-06**	4.570E-03	2.285E-02
2,4-Dimethylpentane	1.025E-02	7.500E-04	1.180E-04	2.213E-05	1.004E-02	**2.575E-06**	5.019E-03	2.510E-02
2,5-Dimethylhexane	7.900E-03	4.500E-04	9.251E-05	1.735E-05	7.868E-03	**2.018E-06**	3.934E-03	1.967E-02
2-Butanone	1.013E-02	7.607E-04	1.164E-04	2.182E-05	9.896E-03	**2.538E-06**	4.948E-03	2.474E-02
2-Butoxyethanol	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Ethyl-1-hexanol	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Furaldehyde	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methyl-1,3-dioxolane	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methyl-1-butene	1.150E-03	ND	1.428E-05	2.677E-06	1.214E-03	**3.114E-07**	6.071E-04	3.035E-03
2-Methyl-1-pentene	7.000E-04	ND	8.712E-06	1.634E-06	7.410E-04	**1.901E-07**	3.705E-04	1.852E-03
2-Methyl-2-butene	4.500E-04	ND	5.580E-06	1.046E-06	4.746E-04	**1.217E-07**	2.373E-04	1.186E-03
2-Methyl-2-pentene	4.500E-04	ND	5.580E-06	1.046E-06	4.746E-04	**1.217E-07**	2.373E-04	1.186E-03
2-Methylfuran	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methylheptane	2.435E-02	7.500E-04	2.932E-04	5.497E-05	2.493E-02	**6.395E-06**	1.247E-02	6.233E-02
2-Methylhexane	5.330E-02	1.750E-03	6.404E-04	1.201E-04	5.446E-02	**1.397E-05**	2.723E-02	1.362E-01
2-Methylnaphthalene	9.285E-03	2.818E-03	1.156E-04	2.167E-05	9.829E-03	**2.521E-06**	4.914E-03	2.457E-02
2-Methylpentane	8.440E-02	1.750E-03	1.027E-03	1.926E-04	8.734E-02	**2.240E-05**	4.367E-02	2.184E-01
2-Methylpropanal	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Methylpropanenitrile	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Pentanone	ND	ND	ND	ND	ND	**ND**	ND	ND
2-Propanol	ND	ND	ND	ND	ND	**ND**	ND	ND
3-Ethylhexane	ND	ND	ND	ND	ND	**ND**	ND	ND
3-Methyl-1-butene	4.000E-04	ND	4.962E-06	9.304E-07	4.220E-04	**1.082E-07**	2.110E-04	1.055E-03
3-Methylhexane	5.790E-02	1.950E-03	6.951E-04	1.303E-04	5.912E-02	**1.516E-05**	2.956E-02	1.478E-01
3-Methylpentane	5.960E-02	1.400E-03	7.232E-04	1.356E-04	6.151E-02	**1.578E-05**	3.075E-02	1.538E-01
4-Methyl-1-pentene	3.000E-04	ND	3.726E-06	6.986E-07	3.169E-04	**8.127E-08**	1.584E-04	7.921E-04
6-Methyl-5-hepten-2-one	ND	6.854E-04	ND	ND	ND	**ND**	ND	ND
Acetic Acid	2.121E-02	1.627E-03	2.431E-04	4.559E-05	2.068E-02	**5.304E-06**	1.034E-02	5.170E-02
Acetone	2.153E-02	5.169E-03	1.849E-04	3.467E-05	1.572E-02	**4.033E-06**	7.862E-03	3.931E-02
Acetonitrile	ND	ND	ND	ND	ND	**ND**	ND	ND
Acetophonone	ND	ND	ND	ND	ND	**ND**	ND	ND
Acetylene	7.800E-03	7.500E-04	8.746E-05	1.640E-05	7.439E-03	**1.908E-06**	3.719E-03	1.860E-02
Acrolein	7.579E-03	ND	9.402E-05	1.763E-05	7.996E-03	**2.051E-06**	3.998E-03	1.999E-02
Acrylonitrile	ND	ND	ND	ND	ND	**ND**	ND	ND
Allylchloride	ND	ND	ND	ND	ND	**ND**	ND	ND

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound (a)	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/item ER_t	* Event Pollutant Emission Rate 5 Items (g/sec) ER_{Ev}
alpha-Pinene	ND	ND	ND	ND	ND	ND	ND	ND
Benzaldehyde	4.159E-02	1.868E-03	4.927E-04	9.238E-05	4.190E-02	1.075E-05	2.095E-02	1.048E-01
Benzene	8.735E-02	3.100E-03	1.047E-03	1.963E-04	8.902E-02	2.283E-05	4.451E-02	2.225E-01
Benzene	8.885E-01	3.153E-03	1.100E-02	2.062E-03	9.353E-01	2.399E-04	4.677E-01	2.338E+00
Benzofuran	ND	ND	ND	ND	ND	ND	ND	ND
Benzonitrile	ND	ND	ND	ND	ND	ND	ND	ND
Benzylchloride	ND	ND	ND	ND	ND	ND	ND	ND
beta-Pinene	ND	ND	ND	ND	ND	ND	ND	ND
Butanal	ND	2.451E-04	ND	ND	ND	ND	ND	ND
Carbon Disulfide	8.522E-03	5.882E-04	9.828E-05	1.843E-05	8.359E-03	2.144E-06	4.179E-03	2.090E-02
Carbontetrachloride	5.539E-04	7.588E-04	ND	ND	ND	ND	ND	ND
Carbonyl Sulfide	2.482E-03	2.681E-04	2.746E-05	5.149E-06	2.335E-03	5.990E-07	1.168E-03	5.838E-03
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethene	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND
cis 1,3-Dichloro-1-propene	ND	ND	ND	ND	ND	ND	ND	ND
cis-2-Butene	5.000E-04	ND	6.203E-06	1.163E-06	5.275E-04	1.353E-07	2.638E-04	1.319E-03
cis-2-Hexene	3.000E-04	ND	3.726E-06	6.986E-07	3.169E-04	8.127E-08	1.584E-04	7.921E-04
cis-2-Pentene	4.000E-04	ND	4.966E-06	9.312E-07	4.224E-04	1.083E-07	2.112E-04	1.056E-03
cis-4-Methyl-2-pentene	ND	ND	ND	ND	ND	ND	ND	ND
Cyanogen	ND	ND	ND	ND	ND	ND	ND	ND
Cyclohexane	4.375E-02	1.200E-03	5.287E-04	9.913E-05	4.496E-02	1.153E-05	2.248E-02	1.124E-01
Cyclohexanone	ND	ND	ND	ND	ND	ND	ND	ND
Cyclopentane	6.950E-03	1.500E-04	8.450E-05	1.584E-05	7.187E-03	1.843E-06	3.593E-03	1.797E-02
Cyclopentanone	ND	ND	ND	ND	ND	ND	ND	ND
Cyclopentene	3.500E-04	ND	4.344E-06	8.145E-07	3.694E-04	9.476E-08	1.847E-04	9.236E-04
Decanal	1.982E-02	2.462E-03	2.157E-04	4.044E-05	1.834E-02	4.705E-06	9.171E-03	4.586E-02
delta 3-Carene	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	2.399E-03	1.434E-03	1.199E-05	2.248E-06	1.020E-03	2.616E-07	5.099E-04	2.549E-03
Dichlorotetrafluoroethane	ND	ND	ND	ND	ND	ND	ND	ND
Dimethyldisulfide	ND	ND	ND	ND	ND	ND	ND	ND
d-Limonene	ND	ND	ND	ND	ND	ND	ND	ND
ETBE	ND	ND	ND	ND	ND	ND	ND	ND
Ethane	1.550E-03	2.300E-03	ND	ND	ND	ND	ND	ND
Ethylbenzene	5.620E-02	4.050E-03	6.478E-04	1.215E-04	5.510E-02	1.413E-05	2.755E-02	1.377E-01
Ethylbenzene	8.628E-01	6.218E-03	1.064E-02	1.995E-03	9.048E-01	2.321E-04	4.524E-01	2.262E+00
Ethylchloride	ND	ND	ND	ND	ND	ND	ND	ND
Ethylcyclohexane	ND	ND	ND	ND	ND	ND	ND	ND
Ethylene	2.045E-02	3.000E-04	2.500E-04	4.688E-05	2.126E-02	5.454E-06	1.063E-02	5.316E-02
Furan	ND	ND	ND	ND	ND	ND	ND	ND

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound (a)	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/item ER_1	* Event Pollutant Emission Rate 5 Items (g/sec) ER_{Ev}
Heptanal	6.326E-03	1.027E-03	6.579E-05	1.233E-05	5.595E-03	1.435E-06	2.797E-03	1.399E-02
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND
Hexanal	ND	1.143E-03	ND	ND	ND	ND	ND	ND
Hexanenitrile	ND	ND	ND	ND	ND	ND	ND	ND
i-Butane	3.150E-03	3.000E-04	3.537E-05	6.631E-06	3.008E-03	7.715E-07	1.504E-03	7.519E-03
i-Butene	5.900E-03	1.000E-04	7.261E-05	1.361E-05	6.175E-03	1.584E-06	3.087E-03	1.544E-02
Indane	1.499E-01	6.217E-03	1.823E-03	3.417E-04	1.550E-01	3.976E-05	7.750E-02	3.875E-01
i-Pentane	8.240E-02	1.250E-03	1.008E-03	1.891E-04	8.576E-02	2.200E-05	4.288E-02	2.144E-01
i-Propylbenzene	2.000E-03	ND	2.483E-05	4.657E-06	2.112E-03	5.418E-07	1.056E-03	5.280E-03
Isoprene	1.000E-04	ND	1.241E-06	2.326E-07	1.055E-04	2.706E-08	5.275E-05	2.638E-04
m&p-Xylene	1.602E+00	1.677E-02	1.969E-02	3.692E-03	1.675E+00	4.295E-04	8.373E-01	4.186E+00
m-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Methacrolein	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Methacrylate	ND	ND	ND	ND	ND	ND	ND	ND
Methylbromide	ND	ND	ND	ND	ND	ND	ND	ND
Methylchloride	ND	ND	ND	ND	ND	ND	ND	ND
Methylchloroform	3.192E-04	3.562E-04	ND	ND	ND	ND	ND	ND
Methylcyclohexane	7.710E-02	2.450E-03	9.275E-04	1.739E-04	7.888E-02	2.023E-05	3.944E-02	1.972E-01
Methylcyclopentane	3.665E-02	1.150E-03	4.411E-04	8.271E-05	3.752E-02	9.623E-06	1.876E-02	9.379E-02
Methylenechloride	8.685E-03	9.779E-04	9.577E-05	1.796E-05	8.145E-03	2.089E-06	4.073E-03	2.036E-02
Methylnitrite	3.564E-02	ND	4.419E-04	8.286E-05	3.758E-02	9.640E-06	1.879E-02	9.396E-02
m-Ethyltoluene	2.435E-02	3.500E-03	2.591E-04	4.857E-05	2.203E-02	5.651E-06	1.102E-02	5.508E-02
Methyl-vinyl Ketone	ND	ND	ND	ND	ND	ND	ND	ND
MTBE	9.000E-02	2.150E-03	1.092E-03	2.047E-04	9.285E-02	2.382E-05	4.642E-02	2.321E-01
MTBE	9.149E-01	2.181E-03	1.134E-02	2.126E-03	9.646E-01	2.474E-04	4.823E-01	2.411E+00
m-Xylene & p-Xylene	1.576E-01	1.660E-02	1.751E-03	3.284E-04	1.489E-01	3.820E-05	7.447E-02	3.723E-01
Naphthalene	7.060E-02	7.803E-03	8.284E-04	1.553E-04	7.045E-02	1.807E-05	3.523E-02	1.761E-01
n-Butane	1.565E-02	5.000E-04	1.881E-04	3.528E-05	1.600E-02	4.104E-06	8.000E-03	4.000E-02
n-Decane	1.900E-03	5.000E-04	2.050E-05	3.844E-06	1.743E-03	4.472E-07	8.717E-04	4.359E-03
n-Heptane	7.575E-02	2.650E-03	9.082E-04	1.703E-04	7.724E-02	1.981E-05	3.862E-02	1.931E-01
n-Hexane	1.002E-01	2.600E-03	1.213E-03	2.274E-04	1.031E-01	2.645E-05	5.156E-02	2.578E-01
Nitromethane	5.490E-03	8.363E-04	6.289E-05	1.179E-05	5.349E-03	1.372E-06	2.675E-03	1.337E-02
n-Nonane	6.700E-03	1.000E-03	7.701E-05	1.444E-05	6.550E-03	1.680E-06	3.275E-03	1.637E-02
n-Octane	2.795E-02	1.100E-03	3.335E-04	6.254E-05	2.837E-02	7.276E-06	1.418E-02	7.092E-02
Nonanal	2.354E-02	4.077E-03	2.418E-04	4.533E-05	2.056E-02	5.274E-06	1.028E-02	5.141E-02
n-Pentane	8.410E-02	1.300E-03	1.029E-03	1.929E-04	8.751E-02	2.245E-05	4.375E-02	2.188E-01
n-Propylbenzene	1.310E-02	1.700E-03	1.416E-04	2.656E-05	1.205E-02	3.090E-06	6.023E-03	3.011E-02
Octanal	1.674E-02	2.349E-03	1.787E-04	3.350E-05	1.519E-02	3.897E-06	7.597E-03	3.799E-02
o-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
o-Ethyltoluene	1.585E-02	2.450E-03	1.665E-04	3.122E-05	1.416E-02	3.632E-06	7.080E-03	3.540E-02

Table B-2: Air Modeling Output Data for Volatile Organic Compounds

Compound (a)	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/item ER_1	* Event Pollutant Emission Rate 5 Items (g/sec) ER_{EV}
o-Xylene	9.875E-02	9.100E-03	1.114E-03	2.088E-04	9.472E-02	**2.430E-05**	4.736E-02	2.368E-01
o-Xylene	1.004E+00	9.256E-03	1.236E-02	2.317E-03	1.051E+00	**2.696E-04**	5.255E-01	2.628E+00
p-Dichlorobenzene	ND	ND	ND	ND	ND	**ND**	ND	ND
Pentanal	ND	1.159E-03	ND	ND	ND	**ND**	ND	ND
Pentanenitrile	ND	ND	ND	ND	ND	**ND**	ND	ND
Perchloroethylene	4.875E-02	ND	6.068E-04	1.138E-04	5.161E-02	**1.324E-05**	2.580E-02	1.290E-01
p-Ethyltoluene	5.335E-02	7.550E-03	5.691E-04	1.067E-04	4.840E-02	**1.241E-05**	2.420E-02	1.210E-01
p-Ethyltoluene	3.565E-01	1.673E-02	4.323E-03	8.105E-04	3.677E-01	**9.430E-05**	1.838E-01	9.191E-01
Phenylacetylene	ND	6.579E-04	ND	ND	ND	**ND**	ND	ND
Propane	7.500E-04	1.000E-03	0.000E+00	0.000E+00	0.000E+00	**0.000E+00**	0.000E+00	0.000E+00
Propanenitrile	ND	ND	ND	ND	ND	**ND**	ND	ND
Propene	9.300E-03	1.000E-04	1.141E-04	2.140E-05	9.707E-03	**2.490E-06**	4.854E-03	2.427E-02
Styrene	1.700E-03	2.000E-04	1.863E-05	3.493E-06	1.584E-03	**4.064E-07**	7.921E-04	3.961E-03
Styrene	1.266E-02	2.439E-04	1.535E-04	2.878E-05	1.305E-02	**3.348E-06**	6.526E-03	3.263E-02
Tetrahydrofuran	ND	ND	ND	ND	ND	**ND**	ND	ND
Thiophene	ND	ND	ND	ND	ND	**ND**	ND	ND
Toluene	2.225E-01	1.890E-02	2.528E-03	4.739E-04	2.150E-01	**5.514E-05**	1.075E-01	5.374E-01
Toluene	2.263E+00	1.922E-02	2.785E-02	5.221E-03	2.368E+00	**6.075E-04**	1.184E+00	5.921E+00
trans 1,3-Dichloro-1-propene	ND	ND	ND	ND	ND	**ND**	ND	ND
trans-2-Butenal	ND	ND	ND	ND	ND	**ND**	ND	ND
trans-2-Butene	1.600E-03	ND	1.985E-05	3.722E-06	1.688E-03	**4.331E-07**	8.442E-04	4.221E-03
trans-2-Hexene	5.500E-04	ND	6.829E-06	1.280E-06	5.808E-04	**1.490E-07**	2.904E-04	1.452E-03
trans-2-Pentene	7.500E-04	ND	9.310E-06	1.746E-06	7.918E-04	**2.031E-07**	3.959E-04	1.980E-03
Trichloroethylene	ND	ND	ND	ND	ND	**ND**	ND	ND
Trichloromonofluoromethane	2.264E-03	2.506E-03	ND	ND	ND	**ND**	ND	ND
Vinylidenechloride	ND	ND	ND	ND	ND	**ND**	ND	ND

Footnotes:

a: Items in bold represent duplicate values for those compounds that are common for Method TO-14 and TO-12.

NEW = Net Explosive Weight

ND = Not Detected.

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

	Simulator Flash Artillery M110 Average NEW, lb = 0.19 Average Number of Items = 1				Items per event (I): release duration (t): Unit Concentration (UC):	5 2 1.026E-04	items/hour seconds g/m^3/(g/s)	
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/item ER_i	* Event Pollutant Emission Rate 5 Items (g/sec) ER_{Ev}
Particulate/Vapor-phase SVOCs								
1,2,4,5-Tetrachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Naphthoquinone	ND	ND	ND	ND	ND	ND	ND	ND
1-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND
2-Acetylaminofluorene	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	1.074E-02	ND	1.495E-04	2.804E-05	1.272E-02	3.262E-06	6.359E-03	3.179E-02
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Naphthylamine	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Picoline	ND	ND	ND	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	ND	ND	ND
3,3'-Dimethylbenzidine	ND	ND	ND	ND	ND	ND	ND	ND
3-Methylcholanthrene	ND	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	ND	ND	ND
4-Bromophenylphenyl ether	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenylphenyl ether	ND	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol/3-Methylphenol	4.751E-04	ND	6.608E-06	1.239E-06	5.620E-04	1.442E-07	2.810E-04	1.405E-03
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/item ER_1	* Event Pollutant Emission Rate 5 Items (g/sec) ER_{EV}
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitroquinoline-1-oxide	ND	ND	ND	ND	ND	ND	ND	ND
5-Nitro-o-toluidine	ND	ND	ND	ND	ND	ND	ND	ND
7,12-Dimethylbenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	5.057E-04	ND	7.152E-06	1.341E-06	6.083E-04	1.560E-07	3.041E-04	1.521E-03
Acetophenone	ND	1.786E-04	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND
Benz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
Benz(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
Benzoic acid	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl alcohol	5.153E-04	ND	7.259E-06	1.361E-06	6.173E-04	1.583E-07	3.087E-04	1.543E-03
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	ND	ND	ND	ND	ND	ND	ND	ND
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND	ND
Carbazole	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzilate	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND
Diallate	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	9.944E-05	2.247E-04	ND	ND	ND	ND	ND	ND
Dimethylphenethylamine	ND	ND	ND	ND	ND	ND	ND	ND
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	7.337E-04	1.615E-03	ND	ND	ND	ND	ND	ND
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	ND	ND
Diphenylamine/N-NitrosoDPA	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	1.009E-04	ND	1.405E-06	2.635E-07	1.195E-04	3.065E-08	5.975E-05	2.988E-04
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND	ND

Table B-3: Air Modeling Output Data for Semi-Volatile Organic Compounds

Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/lb NEW)	Average Adjusted Emission Factor (lb/item)	Total Mass of Pollutant Emitted (grams/item) M	Pollutant Concentration 5 Items ($grams/m^3$) CONC	Pollutant Emission Rate (g/sec)/item ER_1	Event Pollutant Emission Rate 5 Items (g/sec) ER_{EV}
Hexachloropropene	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND	ND
Isosafrole	ND	ND	ND	ND	ND	ND	ND	ND
Kepone	ND	ND	ND	ND	ND	ND	ND	ND
Methapyrilene	ND	ND	ND	ND	ND	ND	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	2.487E-02	ND	3.473E-04	6.512E-05	2.954E-02	7.577E-06	1.477E-02	7.385E-02
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiethylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosomethylethylamine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosomorpholine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopiperidine	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopyrrolidine	ND	ND	ND	ND	ND	ND	ND	ND
o-Toluidine	ND	ND	ND	ND	ND	ND	ND	ND
p-Chloroaniline	ND	ND	ND	ND	ND	ND	ND	ND
p-Dimethylaminoazobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
Phenacetin	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	2.954E-04	ND	4.172E-06	7.823E-07	3.548E-04	9.102E-08	1.774E-04	8.871E-04
Phenol	ND	ND	ND	ND	ND	ND	ND	ND
Pronamide	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND	ND
Pyridine	ND	ND	ND	ND	ND	ND	ND	ND
Safrole	ND	ND	ND	ND	ND	ND	ND	ND
sym-Trinitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND

Footnotes:
ND = Not Detected
NEW = Met Explosive Weight

APPENDIX C

HEALTH-BASED SCREENING LEVELS AND ACUTE TOXICITY VALUES

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
TSP	12789-66-1	5.00E+01		NA		5.00E+01				0.00E+00
PM_{10}		5.00E+01		NA		5.00E+01				0.00E+00
HCl	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01		7.14E+03	T	7.14E+03
Cl_2	7782-50-5	2.09E-01	nc	3.65E+02	nc	2.09E-01	2.89E+03	2.90E+03	E	2.89E+03
Dioxin TEQ	1746-01-6	4.48E-08	c	4.48E-08	c	4.48E-08		3.50E+00	T	3.50E+00
Carbon Monoxide (CO)	630-08-0	1.57E+02		NA		1.57E+02	2.30E+05	2.28E+05	E	2.30E+05
Nitrogen Oxide (NOx)	10024-97-2	1.00E+02		NA		1.00E+02		2.70E+05	T	2.70E+05
HCl (CEM System)	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01		7.14E+03	T	7.14E+03
Carbon Dioxide (CO_2)	124-38-9	NA		NA		NA		5.40E+07	T	5.40E+07
Sulfur Dioxide (SO_2)	202-58-84	8.00E+01		NA		8.00E+01	7.89E+02	7.86E+02	E	7.89E+02
Aluminum	7429-90-5	NA		3.65E+00	nc	3.65E+00		3.00E+04	T	3.00E+04
Antimony	7440-36-0	NA		1.46E+00	nc	1.46E+00		1.50E+03	T	1.50E+03
Arsenic	7440-38-2	4.47E-04	c	4.15E-04	c	4.47E-04		3.00E+01	T	3.00E+01
Barium	7440-39-3	5.21E-01	nc	5.11E-01	nc	5.21E-01		1.50E+03	T	1.50E+03
Beryllium	7440-41-7	8.00E-04	c	7.45E-04	c	8.00E-04		5.00E+00	T	5.00E+00
Cadmium	7440-43-9	1.07E-03	c	9.94E-04	c	1.07E-03		3.00E+01	T	3.00E+01
Chromium	7440-43-9		c	1.53E-04	c	1.53E-04		1.50E+03	T	1.50E+03
Cobalt	7440-48-4	NA		2.20E+02	nc	2.20E+02		6.00E+01	T	6.00E+01
Copper	7440-50-8	NA		1.46E+02	nc	1.46E+02		3.00E+03	T	3.00E+03
Lead	7439-92-1	1.50E+00		NA		1.50E+00		1.50E+02	T	1.50E+02
Magnesium	7439-95-4	NA		NA		NA		3.00E+04	T	3.00E+04
Manganese	7439-96-5	5.11E-02	nc	5.22E-02	nc	5.11E-02		3.00E+03	T	3.00E+03
Nickel	7440-02-0	NA		7.30E+01	nc	7.30E+01		3.00E+03	T	3.00E+03
Phosphorus	7723-14-0	NA		NA		NA		3.00E+02	T	3.00E+02
Selenium	7782-49-2	NA		1.83E+01	nc	1.83E+01		6.00E+02	T	6.00E+02
Silver	7740-22-4	NA		1.83E+01	nc	1.83E+01				0.00E+00
Thallium	7440-28-0	NA		2.56E-01	nc	2.56E-01				0.00E+00
Zinc	7440-66-6	NA		1.10E+03	nc	1.10E+03		3.00E+04	T	3.00E+04
Mercury	7439-97-6	3.13E-01	nc	3.14E-01	nc	3.13E-01		1.00E+02	T	1.00E+02
TNMHC		NA		NA		NA				0.00E+00
1,1,2,2-Tetrachloroethane	79-34-5	3.31E-02	c	3.13E-02	c	3.31E-02				0.00E+00
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	3.13E+04	nc	3.14E+04	nc	3.13E+04		9.58E+06	T	9.58E+06
1,1,2-Trichloroethane	79-00-5	1.20E-01	c	1.12E-01	c	1.20E-01				0.00E+00
1,1-Dichloroethane	75-34-3	5.21E+02	nc	5.11E+02	nc	5.21E+02				0.00E+00
1,2,4-Trichlorobenzene	120-82-1	2.1E+02	nc	2.08E+02	nc	2.08E+02		3.71E+04	T	3.71E+04
1,2,4-Trimethylbenzene	95-63-6	6.21E+00	nc	6.21E+00	nc	6.21E+00		1.80E+05	T	1.80E+05

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
1,2,4-Trimethylbenzene & sec-Butylbenzene	135-98-8	3.65E+01	nc	3.65E+01	nc	3.65E+01				0.00E+00
1,2-Dibromoethane	106-93-4	8.73E-03	c	8.24E-03	c	8.73E-03				0.00E+00
1,2-Dichloroethane	107-06-2	7.39E-02	c	6.88E-02	c	7.39E-02				0.00E+00
1,2-Dichloroethene	540-59-0	NA		3.29E+01	nc	3.29E+01		2.38E+06	T	2.38E+06
1,2-Dichloropropane	78-87-5	9.89E-02	c	9.21E-02	c	9.89E-02				0.00E+00
1,3,5-Trimethylbenzene	108-67-8	6.21E+00	nc	6.21E+00	nc	6.21E+00		3.68E+05	T	3.68E+05
1,3,5-Trimethylbenzene	108-67-8	6.21E+00	nc	6.21E+00	nc	6.21E+00		3.68E+05	T	3.68E+05
1,3-Butadiene	106-99-0	3.7E-03	c	3.48E-03	c	3.74E-03	2.20E+04	2.21E+04	E	2.20E+04
1,3-Butadiene	106-99-0	3.7E-03	c	3.48E-03	c	3.74E-03	2.20E+04	2.21E+04	E	2.20E+04
1,4-Dioxane	123-91-1	6.11E-01	c	9.13E+01	c	6.11E-01				0.00E+00
1-Butanol	71-36-3	3.65E+02	nc	3.65E+02	nc	3.65E+02				0.00E+00
1-Butene	106-98-9	NA		NA		NA				0.00E+00
1-Hexene	592-41-6	NA		NA		NA		1.03E+05	T	1.03E+05
1-Hydroxy-2-propanone	116-09-6	NA		NA		NA				0.00E+00
1-Methylnaphthalene	90-12-0	NA		NA		NA				0.00E+00
1-Pentene	109-67-1	NA		NA		NA				0.00E+00
1-Propanol	71-23-8	NA		NA		NA				0.00E+00
2,2,4-Trimethylhexane	16747-25-5	NA		NA		NA				0.00E+00
2,2,4-Trimethylpentane	540-84-1	NA		NA		NA		3.50E+05	T	3.50E+05
2,2-Dimethylbutane	75-83-2	NA		NA		NA		1.80E+06	T	1.80E+06
2,2-Dimethylheptane	1071-26-7	NA		NA		NA				0.00E+00
2,2-Dimethylpropane	463-82-1	NA		NA		NA				0.00E+00
2,3,4-Trimethylpentane	565-75-3	NA		NA		NA				0.00E+00
2,3-Butanedione	431-03-8	NA		NA		NA				0.00E+00
2,3-Dihydro-1-methyl-1H-indene	767-58-8	NA		NA		NA				0.00E+00
2,3-Dihydro-4-methyl-1H-indene		NA		NA		NA				0.00E+00
2,3-Dimethylbutane	79-29-8	NA		NA		NA				0.00E+00
2,3-Dimethylhexane	584-94-1	NA		NA		NA				0.00E+00
2,3-Dimethylpentane	565-59-3	NA		NA		NA				0.00E+00
2,4,4-Trimethyl-1-pentene	107-39-1	NA		NA		NA				0.00E+00
2,4,4-Trimethyl-2-pentene	107-40-4	NA		NA		NA				0.00E+00
2,4-Dimethylhexane	589-43-5	NA		NA		NA				0.00E+00
2,4-Dimethylpentane	108-08-7	NA		NA		NA				0.00E+00
2,5-Dimethylhexane	592-13-2	NA		NA		NA				0.00E+00
2-Butanone	78-93-3	1.04E+03	nc	1.04E+03	nc	1.04E+03		8.85E+05	T	8.85E+05
2-Butoxyethanol	111-76-2	2.09E+01	nc	2.08E+01	nc	2.09E+01				0.00E+00
2-Ethyl-1-hexanol	104-76-7	NA		NA		NA				0.00E+00

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
2-Furaldehyde	98-01-1	5.21E+01	nc	3.65E+01	nc	5.21E+01	8.00E+03		E	8.00E+03
2-Methyl-1,3-dioxolane	497-26-7	NA		NA		NA				0.00E+00
2-Methyl-1-butene	563-46-2	NA		NA		NA				0.00E+00
2-Methyl-1-pentene	763-29-1	NA		NA		NA				0.00E+00
2-Methyl-2-butene	513-35-9	NA		NA		NA				0.00E+00
2-Methyl-2-pentene	625-27-4	NA		NA		NA				0.00E+00
2-Methylfuran	534-22-5	NA		NA		NA				0.00E+00
2-Methylheptane	592-27-8	NA		NA		NA				0.00E+00
2-Methylhexane	591-76-4	NA		NA		NA				0.00E+00
2-Methylnaphthalene	91-57-6	NA		7.30E+01	nc	7.30E+01		2.00E+04	T	2.00E+04
2-Methylpentane	107-83-5	NA		NA		NA		1.80E+06	T	1.80E+06
2-Methylpropanal	78-84-2	NA		NA		NA				0.00E+00
2-Methylpropanenitrile	78-82-0	NA		NA		NA				0.00E+00
2-Nitrophenol	88-75-5	NA		NA		NA				0.00E+00
2-Pentanone	107-87-9	NA		NA		NA		8.80E+05	T	8.80E+05
2-Propanol	67-63-0	NA		NA		NA				0.00E+00
3-Ethylhexane	619-99-8	NA		NA		NA				0.00E+00
3-Methyl-1-butene	563-45-1	NA		NA		NA				0.00E+00
3-Methylhexane	589-34-4	NA		NA		NA				0.00E+00
3-Methylpentane	96-14-0	NA		NA		NA				0.00E+00
4-Methyl-1-pentene	691-37-2	NA		NA		NA				0.00E+00
6-Methyl-5-hepten-2-one	101-99-0	NA		NA		NA				0.00E+00
Acetic Acid	64-19-7	NA		NA		NA		3.68E+04	T	3.68E+04
Acetone	67-64-1	3.65E+02	nc	3.65E+02	nc	3.65E+02		2.37E+06	T	2.37E+06
Acetonitrile	75-05-8	6.2E+01	nc	6.21E+01	nc	6.21E+01		1.01E+05	T	1.01E+05
Acetophenone	98-86-2	2.08E-02	nc	2.08E-02	nc	2.08E-02		3.00E+04	T	3.00E+04
Acetylene	74-86-2	NA		NA		NA				0.00E+00
Acrolein	107-02-8	2.09E-02	nc	2.08E-02	nc	2.09E-02	2.30E+02	2.29E+02	E	2.30E+02
Acrylonitrile	107-13-1	2.83E-02	c	2.61E-02	c	2.83E-02	2.20E+04		E	2.20E+04
Allylchloride	107-05-1	1.04E+00	nc	NA		1.04E+00				0.00E+00
alpha-Pinene	80-56-8	NA		NA		NA				0.00E+00
Benzaldehyde	100-52-7	3.65E+02	nc	3.65E+02	nc	3.65E+02		1.50E+04	T	1.50E+04
Benzene	71-43-2	2.5E-01	c	2.16E-01	c	2.49E-01	1.56E+05	1.60E+05	E	1.56E+05
Benzene	71-43-2	2.5E-01	c	2.16E-01	c	2.49E-01	1.56E+05	1.60E+05	E	1.56E+05
Benzofuran	271-89-6	NA		NA		NA				0.00E+00
Benzonitrile	100-47-0	NA		NA		NA		1.50E+04	T	1.50E+04
Benzylchloride	100-44-7	3.96E-02	c	3.68E-02	c	3.96E-02				0.00E+00

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
beta-Pinene	127-91-3	NA		NA		NA				0.00E+00
Butanal	123-72-8	NA		NA		NA		7.38E+04	T	7.38E+04
Carbon Disulfide	75-15-0	7.30E+02	nc	7.30E+02	nc	7.30E+02	3.10E+03	3.73E+04	E	3.10E+03
Carbontetrachloride	56-23-5	1.28E-01	c	1.18E-01	c	1.28E-01	1.28E+05		E	1.28E+05
Carbonyl Sulfide	463-58-1	NA		NA		NA		9.84E+03	T	9.84E+03
Chlorobenzene	108-90-7	6.2E+01	nc	6.21E+01	nc	6.21E+01				0.00E+00
Chloroethene	75-01-4	2.24E-02	c	2.09E-02	c	2.24E-02				0.00E+00
Chloroform	67-66-3	8.35E-02	c	7.73E-02	c	8.35E-02	2.48E+05		E	2.48E+05
cis 1,3-Dichloro-1-propene	10061-01-5	5.17E-02	c	4.82E-02	c	5.17E-02				0.00E+00
cis-2-Butene	590-18-1	NA		NA		NA				0.00E+00
cis-2-Hexene	7688-21-3	NA		NA		NA				0.00E+00
cis-2-Pentene	627-20-3	NA		NA		NA				0.00E+00
cis-4-Methyl-2-pentene	691-38-3	NA		NA		NA				0.00E+00
Cyanogen	2074-87-5	NA		NA		NA				0.00E+00
Cyclohexane	110-82-7	NA		NA		NA		3.10E+06	T	3.10E+06
Cyclohexanone	108-94-1	1.83E+04	nc	1.83E+04	nc	1.83E+04				0.00E+00
Cyclopentane	278-92-3	NA		NA		NA				0.00E+00
Cyclopentanone	120-92-3	NA		NA		NA				0.00E+00
Cyclopentene	142-29-0	NA		NA		NA				0.00E+00
Decanal	112-31-2	NA		NA		NA				0.00E+00
delta 3-Carene	13466-78-9	NA		NA		NA				0.00E+00
Dichlorodifluoromethane	75-71-8	2.09E+02	nc	1.83E+02	nc	2.09E+02		1.48E+07	T	1.48E+07
Dichlorotetrafluoroethane	1320-37-2	NA		NA		NA				0.00E+00
Dimethyldisulfide	624-92-0	NA		NA		NA				0.00E+00
d-Limonene	5989-27-5	NA		NA		NA				0.00E+00
ETBE	637-92-3	NA		NA		NA				0.00E+00
Ethane	74-84-0	NA		NA		NA				0.00E+00
Ethylbenzene	100-41-4	1.06E+03	nc	1.06E+03	nc	1.06E+03		5.43E+05	T	5.43E+05
Ethylbenzene	100-41-4	1.06E+03	nc	1.06E+03	nc	1.06E+03		5.43E+05	T	5.43E+05
Ethylchloride	75-00-3	2.3E+00	nc	NA		2.32E+00				0.00E+00
Ethylcyclohexane	1678-91-7	NA		NA		NA				0.00E+00
Ethylene	74-85-1	NA		NA		NA		4.60E+05	T	4.60E+05
Furan	110-00-9	3.65E+00	nc	3.65E+00	nc	3.65E+00		1.67E+02	T	1.67E+02
Heptanal	111-71-7	NA		NA		NA				0.00E+00
Hexachlorobutadiene	87-68-3	8.73E-02	c	8.03E-02	c	8.73E-02				0.00E+00
Hexanal	66-25-1	NA		NA		NA				0.00E+00
Hexanenitrile	628-73-9	NA		NA		NA				0.00E+00

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
i-Butane	75-28-5	NA		NA		NA		9.52E+05	T	9.52E+05
i-Butene	115-11-7	NA		NA		NA		6.87E+06	T	6.87E+06
Indane	496-11-7	NA		NA		NA		1.25E+05	T	1.25E+05
i-Pentane	78-78-4	NA		NA		NA				0.00E+00
i-Propylbenzene	98-82-8	4.02E+02	nc	4.02E+02	nc	4.02E+02				0.00E+00
Isoprene	78-79-5	NA		NA		NA				0.00E+00
m&p-Xylene	108-38-3 106-42-3	7.30E+02	nc	7.30E+03	nc	7.30E+02		6.51E+05	T	6.51E+05
m-Dichlorobenzene	541-73-1	3.3E+00	nc	3.29E+00	nc	3.29E+00				0.00E+00
Methacrolein	78-85-3	NA		NA		NA				0.00E+00
Methyl Methacrylate	80-62-6	7.30E+02	nc	7.30E+02	nc	7.30E+02				0.00E+00
Methylbromide	74-83-9	5.21E+00	nc	5.11E+00	nc	5.21E+00				0.00E+00
Methylchloride	74-87-3	1.07E+00	c	1.79E+00	c	1.07E+00				0.00E+00
Methylchloroform	71-55-6	1.04E+03	nc	1.04E+03	nc	1.04E+03	1.94E+06		E	1.94E+06
Methylcyclohexane	108-87-2	3.13E+03	nc	3.14E+03	nc	3.13E+03		4.81E+06	T	4.81E+06
Methylcyclopentane	96-37-7	NA		NA		NA				0.00E+00
Methylenechloride	75-09-2	4.09E+00	c	3.79E+00	c	4.09E+00	6.96E+05	6.94E+05	E	6.96E+05
Methylnitrite	624-91-9	NA		NA		NA				0.00E+00
m-Ethyltoluene	620-14-4	NA		NA		NA				0.00E+00
Methyl-vinyl Ketone	78-94-4	NA		NA		NA		8.61E+01	T	8.61E+01
MTBE	1634-04-4	3.13E+03	nc	3.13E+03	nc	3.13E+03		4.32E+05	T	4.32E+05
MTBE	1634-04-4	3.13E+03	nc	3.13E+03	nc	3.13E+03		4.32E+05	T	4.32E+05
m-Xylene & p-Xylene	108-38-3 106-42-3	7.30E+02	nc	7.30E+03	nc	7.30E+02		6.51E+05	T	6.51E+05
Naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00		7.86E+04	T	7.86E+04
n-Butane	106-97-8	NA		NA		NA				0.00E+00
n-Decane	124-18-5	NA		NA		NA		4.37E+03	T	4.37E+03
n-Heptane	142-82-5	NA		NA		NA		1.80E+06	T	1.80E+06
n-Hexane	110-54-3	2.09E+02	nc	2.08E+02	nc	2.09E+02		5.28E+05	T	5.28E+05
Nitromethane	75-52-5	NA		NA		NA		1.50E+05	T	1.50E+05
n-Nonane	111-84-2	NA		NA		NA		1.05E+06	T	1.05E+06
n-Octane	111-65-9	NA		NA		NA				0.00E+00
Nonanal	124-19-6	NA		NA		NA				0.00E+00
n-Pentane	109-66-0	NA		NA		NA		1.80E+06	T	1.80E+06
n-Propylbenzene	103-65-1	3.65E+01	nc	NA		3.65E+01		3.68E+05	T	3.68E+05
Octanal	124-13-0	NA		NA		NA				0.00E+00
o-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02				0.00E+00
o-Ethyltoluene	611-14-3	NA		NA		NA		7.50E+02	T	7.50E+02

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
o-Xylene	95-47-6	7.30E+02	nc	7.30E+03	nc	7.30E+02		6.51E+05	T	6.51E+05
o-Xylene	95-47-6	7.30E+02	nc	7.30E+03	nc	7.30E+02		6.51E+05	T	6.51E+05
p-Dichlorobenzene	106-46-7	2.80E-01	c	2.85E-01	c	2.80E-01				0.00E+00
Pentanal	110-62-3	NA		NA		NA				0.00E+00
Pentanenitrile	110-59-8	NA		NA		NA				0.00E+00
Perchloroethylene	127-18-4	3.31E+00	c	3.13E+00	c	3.31E+00	6.89E+05	6.78E+05	E	6.89E+05
p-Ethyltoluene	622-96-8	NA		NA		NA		1.25E+05	T	1.25E+05
p-Ethyltoluene	622-96-8	NA		NA		NA		1.25E+05	T	1.25E+05
Phenylacetylene	536-74-3	NA		NA		NA				0.00E+00
Propane	74-98-6	NA		NA		NA		3.78E+06	T	3.78E+06
Propanenitrile	107-12-0	NA		NA		NA		3.38E+04	T	3.38E+04
Propene	115-07-1	NA		NA		NA				0.00E+00
Styrene	100-42-5	1.06E+03	nc	1.04E+03	nc	1.06E+03	2.13E+05	2.13E+05	E	2.13E+05
Styrene	100-42-5	1.06E+03	nc	1.04E+03	nc	1.06E+03	2.13E+05	2.13E+05	E	2.13E+05
Tetrahydrofuran	109-99-9	9.9E-01	nc	9.21E-01	c	9.89E-01				0.00E+00
Thiophene	110-02-1	NA		NA		NA				0.00E+00
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02	1.88E+05	1.89E+05	E	1.88E+05
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02	1.88E+05	1.89E+05	E	1.88E+05
trans 1,3-Dichloro-1-propene	10061-02-6	NA		NA		NA				0.00E+00
trans-2-Butenal	123-73-9	3.54E-03	c	3.30E-03	c	3.54E-03				0.00E+00
trans-2-Butene	624-64-6	NA		NA		NA				0.00E+00
trans-2-Hexene	4050-45-7	NA		NA		NA				0.00E+00
trans-2-Pentene	646-04-8	NA		NA		NA				0.00E+00
Trichloroethylene	79-01-6	1.12E+00	c	1.04E+00	c	1.12E+00				0.00E+00
Trichloromonofluoromethane	75-69-4	7.30E+02	nc	7.30E+02	nc	7.30E+02				0.00E+00
Vinylidenechloride	75-35-4	3.84E-02	c	3.58E-02	c	3.84E-02				0.00E+00
1,2,4,5-Tetrachlorobenzene	95-94-3	1.10E+00	nc	1.10E+00	nc	1.10E+00				0.00E+00
1,2,4-Trichlorobenzene	120-82-1	2.08E+02	nc	2.08E+02	nc	2.08E+02				0.00E+00
1,2-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02				0.00E+00
1,3-Dichlorobenzene	541-73-1	3.3E+00	nc	3.29E+00	nc	3.29E+00				0.00E+00
1,3-Dinitrobenzene	99-65-0	3.65E-01	nc	3.65E-01	nc	3.65E-01				0.00E+00
1,4-Dichlorobenzene	106-46-7	3.1E-01	c	2.85E-01	c	3.06E-01				0.00E+00
1,4-Naphthoquinone	130-15-4	NA		NA		NA				0.00E+00
1-Naphthylamine	134-32-7	NA		NA		NA				0.00E+00
2,3,4,6-Tetrachlorophenol	58-90-2	1.10E+02	nc	1.10E+02	nc	1.10E+02				0.00E+00
2,4,5-Trichlorophenol	95-95-4	3.65E+02	nc	3.65E+02	nc	3.65E+02				0.00E+00
2,4,6-Trichlorophenol	88-06-2	6.20E-01	c	6.26E-01	c	6.20E-01				0.00E+00

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
2,4-Dichlorophenol	120-83-2	1.10E+01	nc	1.10E+01	nc	1.10E+01				0.00E+00
2,4-Dimethylphenol	105-67-9	7.30E+01	nc	7.30E+01	nc	7.30E+01				0.00E+00
2,4-Dinitrophenol	51-28-5	7.30E+00	nc	7.30E+00	nc	7.30E+00				0.00E+00
2,4-Dinitrotoluene	121-14-2	7.30E+00	nc	7.30E+00	nc	7.30E+00				0.00E+00
2,6-Dichlorophenol	87-65-0	NA		NA		NA				0.00E+00
2,6-Dinitrotoluene	606-20-2	3.7E+00	nc	3.65E+00	nc	3.65E+00				0.00E+00
2-Acetylaminofluorene	53-96-3	NA		NA		NA				0.00E+00
2-Chloronaphthalene	91-58-7	2.92E+02	nc	2.92E+02	nc	2.92E+02				0.00E+00
2-Chlorophenol	95-57-8	1.83E+01	nc	1.83E+01	nc	1.83E+01				0.00E+00
2-Methylnaphthalene	91-57-6	NA		7.30E+01	nc	7.30E+01		2.00E+04	T	2.00E+04
2-Methylphenol	95-48-7	1.83E+02	nc	1.83E+02	nc	1.83E+02				0.00E+00
2-Naphthylamine	91-59-8	NA		NA		NA				0.00E+00
2-Nitroaniline	88-74-4	2.09E-01	nc	2.08E-01	nc	2.09E-01				0.00E+00
2-Nitrophenol	88-75-5	NA		NA		NA				0.00E+00
2-Picoline	109-06-8	NA		NA		NA				0.00E+00
3,3'-Dichlorobenzidine	91-94-1	1.49E-02	c	1.39E-02	c	1.49E-02				0.00E+00
3,3'-Dimethylbenzidine	119-93-7	7.31E-04	c	6.81E-04	c	7.31E-04				0.00E+00
3-Methylcholanthrene	56-49-5	NA		NA		NA				0.00E+00
3-Nitroaniline	99-09-2	NA		NA		NA				0.00E+00
4,6-Dinitro-2-methylphenol	534-52-1	NA		3.65E-01	nc	3.65E-01				0.00E+00
4-Aminobiphenyl	92-67-1	NA		NA		NA				0.00E+00
4-Bromophenylphenyl ether	101-55-3	NA		NA		NA				0.00E+00
4-Chloro-3-methylphenol	35421-08-8	NA		NA		NA				0.00E+00
4-Chlorophenylphenyl ether	7005-72-3	NA		NA		NA				0.00E+00
4-Methylphenol/3-Methylphenol	106-44-5	1.83E+01	nc	1.83E+01	nc	1.83E+01				0.00E+00
4-Nitroaniline	100-01-6	NA		NA		NA				0.00E+00
4-Nitrophenol	100-02-7	2.9E+01	nc	2.92E+01	nc	2.92E+01				0.00E+00
4-Nitroquinoline-1-oxide	56-57-5	NA		NA		NA				0.00E+00
5-Nitro-o-toluidine	99-52-5	NA		NA		NA				0.00E+00
7,12-Dimethylbenz(a)anthracene	57-97-6	NA		NA		NA				0.00E+00
Acenaphthene	83-32-9	2.19E+02	nc	2.19E+02	nc	2.19E+02				0.00E+00
Acenaphthylene	208-96-8	NA		NA		NA		2.00E+02	T	2.00E+02
Acetophenone	98-86-2	2.08E-02	nc	2.08E-02	nc	2.08E-02		3.00E+04	T	3.00E+04
Aniline	62-53-3	1.04E+00	nc	1.06E+00	nc	1.04E+00		2.29E+04	T	2.29E+04
Anthracene	120-12-7	1.10E+03	nc	1.10E+03	nc	1.10E+03				0.00E+00
Benz(a)anthracene	56-55-3	2.17E-02	c	8.58E-03	c	2.17E-02				0.00E+00
Benz(a)pyrene	50-32-8	2.17E-03	c	2.02E-03	c	2.17E-03				0.00E+00

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
Benzidine	92-87-5	2.92E-05	c	2.72E-05	c	2.92E-05				0.00E+00
Benzo(b)fluoranthene	205-99-2	2.17E-02	c	8.58E-03	c	2.17E-02				0.00E+00
Benzo(g,h,i)perylene	191-24-2	NA		NA		NA				0.00E+00
Benzo(k)fluoranthene	207-08-9	2.17E-01	c	8.58E-02	c	2.17E-01				0.00E+00
Benzoic acid	65-85-0	1.46E+04	nc	1.46E+04	nc	1.46E+04				0.00E+00
Benzyl alcohol	100-51-6	1.10E+03	nc	1.10E+03	nc	1.10E+03		5.53E+04	T	5.53E+04
bis(2-Chloroethoxy)methane	111-91-1	NA		NA		NA				0.00E+00
bis(2-Chloroethyl)ether	111-44-4	5.82E-03	c	5.69E-03	c	5.82E-03				0.00E+00
bis(2-Chloroisopropyl)ether	108-60-1	1.92E-01	c	1.79E-01	c	1.92E-01				0.00E+00
bis(2-Ethylhexyl)phthalate	117-81-7	4.80E-01	c	4.47E-01	c	4.80E-01				0.00E+00
Butylbenzylphthalate	85-68-7	7.30E+02	nc	7.30E+02	nc	7.30E+02		5.00E+05	T	5.00E+05
Carbazole	86-74-8	3.36E-01	c	3.13E-01	c	3.36E-01				0.00E+00
Chlorobenzilate	510-15-6	2.49E-02	c	2.32E-02	c	2.49E-02				0.00E+00
Chrysene	218-01-9	2.17E+00	c	8.58E-01	c	2.17E+00				0.00E+00
Diallate	2303-16-4	1.10E-01	c	NA		1.10E-01				0.00E+00
Dibenz(a,h)anthracene	53-70-3	2.17E-03	c	8.58E-04	c	2.17E-03				0.00E+00
Dibenzofuran	132-64-9	1.46E+01	nc	1.46E+01	nc	1.46E+01				0.00E+00
Diethylphthalate	84-66-2	2.92E+03	nc	2.92E+03	nc	2.92E+03		1.50E+04	T	1.50E+04
Dimethylphenethylamine	122-09-8	3.65E+00	nc	NA		3.65E+00				0.00E+00
Dimethylphthalate	131-11-3	3.65E+04	nc	3.65E+04	nc	3.65E+04				0.00E+00
Di-n-butylphthalate	84-74-2	3.65E+02	nc	3.65E+02	nc	3.65E+02		1.50E+04	T	1.50E+04
Di-n-octylphthalate	117-84-0	7.30E+01	nc	7.30E+01	nc	7.30E+01		1.50E+05	T	1.50E+05
Diphenylamine/N-NitrosoDPA	122-39-4	9.13E+01	nc	9.13E+01	nc	9.13E+01				0.00E+00
Ethyl methanesulfonate	62-50-0	NA		NA		NA				0.00E+00
Fluoranthene	206-44-0	1.46E+02	nc	1.46E+02	nc	1.46E+02				0.00E+00
Fluorene	86-73-7	1.46E+02	nc	1.46E+02	nc	1.46E+02		7.50E+04	T	7.50E+04
Hexachlorobenzene	118-74-1	4.18E-03	c	3.91E-03	c	4.18E-03				0.00E+00
Hexachlorobutadiene	87-68-3	8.6E-02	c	8.03E-02	c	8.62E-02				0.00E+00
Hexachlorocyclopentadiene	77-47-4	7.30E-02	nc	7.30E-02	nc	7.30E-02				0.00E+00
Hexachloroethane	67-72-1	4.80E-01	c	4.47E-01	c	4.80E-01				0.00E+00
Hexachloropropene	1888-71-7	NA		NA		NA				0.00E+00
Indeno(1,2,3-cd)pyrene	193-39-5	2.17E-02	c	8.58E-03	c	2.17E-02				0.00E+00
Isophorone	78-59-1	7.08E+00	c	6.59E+00	c	7.08E+00				0.00E+00
Isosafrole	120-58-1	NA		NA		NA				0.00E+00
Kepone	143-50-0	3.74E-04	c	NA		3.74E-04				0.00E+00
Methapyrilene	91-80-5	NA		NA		NA				0.00E+00
Methyl methanesulfonate	66-27-3	NA		NA		NA				0.00E+00

Appendix C: Health-based Screening Levels and Acute Toxicity Values

		For the Chronic Evaluation (HBSL)					For the Acute Evaluation (ATV)			
Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 9 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Health-based Screening Level ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	Source (T or E)	Acute Toxicity Value ($\mu g/m^3$)
Naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00		7.86E+04	T	7.86E+04
Nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc	2.09E+00				0.00E+00
N-Nitrosodimethylamine	55-18-5	4.47E-05	c	4.17E-05	c	4.47E-05				0.00E+00
N-Nitrosodimethylamine	55-18-5	4.47E-05	c	4.17E-05	c	4.47E-05				0.00E+00
N-Nitroso-di-n-butylamine	924-16-3	1.2E-03	c	1.12E-03	c	1.20E-03				0.00E+00
N-Nitroso-di-n-propylamine	621-64-7	9.61E-04	c	8.94E-04	c	9.61E-04				0.00E+00
N-Nitrosomethylethylamine	10595-95-6	3.06E-04	c	2.85E-04	c	3.06E-04				0.00E+00
N-Nitrosomorpholine	59-89-2	NA		NA		NA				0.00E+00
N-Nitrosopiperidine	100-75-4	NA		NA		NA				0.00E+00
N-Nitrosopyrrolidine	930-55-2	3.15E-03	c	NA		3.15E-03				0.00E+00
o-Toluidine	95-53-4	2.80E-02	c	NA		2.80E-02				0.00E+00
p-Chloroaniline	106-47-8	1.46E+01	nc	1.46E+01	nc	1.46E+01				0.00E+00
p-Dimethylaminoazobenzene	60-11-7	NA		NA		NA				0.00E+00
Pentachlorobenzene	608-93-5	2.92E+00	nc	2.92E+00	nc	2.92E+00				0.00E+00
Pentachloroethane	76-01-7	NA		NA		NA				0.00E+00
Pentachloronitrobenzene	82-68-8	2.59E-02	c	2.41E-02	c	2.59E-02				0.00E+00
Pentachlorophenol	87-86-5	5.60E-02	c	5.22E-02	c	5.60E-02				0.00E+00
Phenacetin	62-44-2	NA		NA		NA				0.00E+00
Phenanthrene	85-01-8	NA		NA		NA		2.00E+03	T	2.00E+03
Phenol	108-95-2	2.19E+03	nc	2.19E+03	nc	2.19E+03				0.00E+00
Pronamide	23950-58-5	2.74E+02	nc	NA		2.74E+02				0.00E+00
Pyrene	129-00-1	NA		NA		NA				0.00E+00
Pyridine	110-86-1	3.65E+00	nc	3.65E+00	nc	3.65E+00				0.00E+00
Safrole	94-59-7	NA		NA		NA				0.00E+00
sym-Trinitrobenzene	99-35-4	1.10E+02	nc	1.10E+02	nc	1.10E+02				0.00E+00

Footnotes:
PRG: Preliminary Remediation Goals
c: Cancer
nc:non-cancer
RBC: Risk-Based Concentration
HBSL: Health-based Screening Level
(E) ERPG: Emergency Response Planning Guidelines
(T) TEEL: Temporary Emergency Exposure Limits
ATV: Acute Toxicity Value
NA: Not applicable

APPENDIX D

RISK EVALUATION DATA

Table D-1: Comparison of Air Concentrations With Health-Based Values: Metals, Particulates and Miscellaneous Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
TSP	3.75E-01	5.00E+01	7.50E-03	no	NA	NV		na
PM_{10}	5.54E-01	5.00E+01	1.11E-02	no	NA	NV		na
HCl (a)	1.03E-03	2.08E+01	4.95E-05	no	3.62E+00	7.14E+03	5.07E-04	no
Cl_2 (a)	3.78E-04	2.09E-01	1.81E-03	no	3.31E-01	2.89E+03	1.15E-04	no
Dioxin TEQ (b)	4.12E-12	4.48E-08	9.20E-05	no	3.37E-08	3.50E+00	9.63E-09	no
Carbon Monoxide (CO)	4.63E-02	1.57E+02	2.95E-04	no	4.05E+01	2.30E+05	1.76E-04	no
Nitrogen Oxide (NOx)	1.34E-02	1.00E+02	1.34E-04	no	4.70E+01	2.70E+05	1.74E-04	no
HCl (a)	1.84E-04	2.08E+01	8.81E-06	no	6.43E-01	7.14E+03	9.01E-05	no
Carbon Dioxide (CO_2)	1.76E+00	NV		na	6.18E+03	5.40E+07	1.14E-04	no
Sulfur Dioxide (SO_2)	1.07E-03	8.00E+01	1.34E-05	no	9.41E-01	7.89E+02	1.19E-03	no
Aluminum	2.08E-03	3.65E+00	5.71E-04	no	7.30E+00	3.00E+04	2.43E-04	no
Antimony	2.95E-04	1.46E+00	2.02E-04	no	1.03E+00	1.50E+03	6.90E-04	no
Arsenic	NA	4.47E-04		na	NA	3.00E+01		na
Barium	2.26E-02	5.21E-01	4.33E-02	no	7.90E+01	1.50E+03	5.27E-02	no
Beryllium	NA	8.00E-04		na	NA	5.00E+00		na
Cadmium	8.68E-07	1.07E-03	8.13E-04	no	7.09E-03	3.00E+01	2.36E-04	no
Chromium	2.40E-05	1.53E-04	1.57E-01	no	1.96E-01	1.50E+03	1.31E-04	no
Cobalt	6.36E-06	2.20E+02	2.89E-08	no	2.23E-02	6.00E+01	3.71E-04	no
Copper	5.01E-04	1.46E+02	3.43E-06	no	1.76E+00	3.00E+03	5.85E-04	no
Lead	7.14E-05	1.50E+00	4.76E-05	no	2.50E-01	1.50E+02	1.67E-03	no
Magnesium	1.05E-01	NV		na	3.68E+02	3.00E+04	1.23E-02	no
Manganese	8.36E-05	5.11E-02	1.64E-03	no	2.93E-01	3.00E+03	9.76E-05	no
Nickel	3.40E-06	7.30E+01	4.65E-08	no	1.19E-02	3.00E+03	3.97E-06	no
Phosphorus	4.05E-05	NV		na	1.42E-01	3.00E+02	4.73E-04	no
Selenium	NA	1.83E+01		na	NA	6.00E+02		na
Silver	NA	1.83E+01		na	NA	NV		na
Thallium	NA	2.56E-01		na	NA	NV		na
Zinc	1.12E-04	1.10E+03	1.02E-07	no	3.93E-01	3.00E+04	1.31E-05	no
Mercury	NA	3.13E-01		na	NA	1.00E+02		na

Footnote:

(a) HCl/Cl_2 levels were too low to be reliably measured.

(b) Presence questionable - reported at similar levels in samples and blanks.

NA = Not applicable because compound was not detected.

na = Not available because health-based screening value is not available or not applicable if compound was not detected.

NV = No value

$C_{chronic}$ = Chronic time-averaged concentration ; HBSL = Chronic health-based screening level

C_{acute} = Acute concentration; ATV = Acute toxicity value

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
TNMHC	3.59E-02	NV		na	NA	NV		na
1,1,2,2-Tetrachloroethane	NA	3.31E-02		na	NA	NV		na
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	3.13E+04		na	NA	9.58E+06		na
1,1,2-Trichloroethane	NA	1.20E-01		na	NA	NV		na
1,1-Dichloroethane	NA	5.21E+02		na	NA	NV		na
1,2,4-Trichlorobenzene	NA	2.08E+02		na	NA	3.71E+04		na
1,2,4-Trimethylbenzene	1.13E-02	6.21E+00	1.82E-03	no	3.96E+01	1.80E+05	2.20E-04	no
1,2,4-Trimethylbenzene & sec-Butylbenzene	1.19E-03	3.65E+01	3.25E-05	no	NA	NV		na
1,2-Dibromoethane	NA	8.73E-03		na	NA	NV		na
1,2-Dichloroethane	NA	7.39E-02		na	NA	NV		na
1,2-Dichloroethene	NA	3.29E+01		na	NA	2.38E+06		na
1,2-Dichloropropane	NA	9.89E-02		na	NA	NV		na
1,3,5-Trimethylbenzene	4.99E-04	6.21E+00	8.05E-05	no	1.75E+00	3.68E+05	4.75E-06	no
1,3,5-Trimethylbenzene	5.83E-03	6.21E+00	9.39E-04	no	2.04E+01	3.68E+05	5.55E-05	no
1,3-Butadiene	1.36E-05	3.74E-03	3.64E-03	no	2.78E-02	2.20E+04	1.26E-06	no
1,3-Butadiene	1.38E-04	3.74E-03	3.71E-02	no	2.83E-01	2.20E+04	1.29E-05	no
1,4-Dioxane	NA	6.11E-01		na	NA	NV		na
1-Butanol	NA	3.65E+02		na	NA	NV		na
1-Butene	3.86E-05	NV		na	NA	NV		na
1-Hexene	6.89E-06	NV		na	2.41E-02	1.03E+05	2.34E-07	no
1-Hydroxy-2-propanone	NA	NV		na	NA	NV		na
1-Methylnaphthalene	NA	NV		na	NA	NV		na
1-Pentene	1.37E-05	NV		na	NA	NV		na
1-Propanol	NA	NV		na	NA	NV		na
2,2,4-Trimethylhexane	2.66E-05	NV		na	NA	NV		na
2,2,4-Trimethylpentane	2.43E-04	NV		na	8.53E-01	3.50E+05	2.44E-06	no
2,2-Dimethylbutane	1.25E-04	NV		na	4.37E-01	1.80E+06	2.43E-07	no
2,2-Dimethylheptane	NA	NV		na	NA	NV		na
2,2-Dimethylpropane	NA	NV		na	NA	NV		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
2,3,4-Trimethylpentane	4.21E-05	NV		na	NA	NV		na
2,3-Butanedione	NA	NV		na	NA	NV		na
2,3-Dihydro-1-methyl-1H-indene	7.75E-04	NV		na	NA	NV		na
2,3-Dihydro-4-methyl-1H-indene	9.77E-04	NV		na	NA	NV		na
2,3-Dimethylbutane	2.78E-04	NV		na	NA	NV		na
2,3-Dimethylhexane	7.39E-05	NV		na	NA	NV		na
2,3-Dimethylpentane	2.67E-04	NV		na	NA	NV		na
2,4,4-Trimethyl-1-pentene	NA	NV		na	NA	NV		na
2,4,4-Trimethyl-2-pentene	NA	NV		na	NA	NV		na
2,4-Dimethylhexane	1.49E-04	NV		na	NA	NV		na
2,4-Dimethylpentane	1.63E-04	NV		na	NA	NV		na
2,5-Dimethylhexane	1.28E-04	NV		na	NA	NV		na
2-Butanone	1.61E-04	1.04E+03	1.54E-07	no	5.64E-01	8.85E+05	6.37E-07	no
2-Butoxyethanol	NA	2.09E+01		na	NA	NV		na
2-Ethyl-1-hexanol	NA	NV		na	NA	NV		na
2-Furaldehyde	NA	5.21E+01		na	NA	8.00E+03		na
2-Methyl-1,3-dioxolane	NA	NV		na	NA	NV		na
2-Methyl-1-butene	1.98E-05	NV		na	NA	NV		na
2-Methyl-1-pentene	1.21E-05	NV		na	NA	NV		na
2-Methyl-2-butene	7.72E-06	NV		na	NA	NV		na
2-Methyl-2-pentene	7.72E-06	NV		na	NA	NV		na
2-Methylfuran	NA	NV		na	NA	NV		na
2-Methylheptane	4.06E-04	NV		na	NA	NV		na
2-Methylhexane	8.86E-04	NV		na	NA	NV		na
2-Methylnaphthalene	1.60E-04	7.30E+01	2.19E-06	no	5.60E-01	2.00E+04	2.80E-05	no
2-Methylpentane	1.42E-03	NV		na	4.98E+00	1.80E+06	2.77E-06	no
2-Methylpropanal	NA	NV		na	NA	NV		na
2-Methylpropanenitrile	NA	NV		na	NA	NV		na
2-Nitrophenol	NA	NV		na	NA	NV		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
2-Pentanone	NA	NV		na	NA	8.80E+05		na
2-Propanol	NA	NV		na	NA	NV		na
3-Ethylhexane	NA	NV		na	NA	NV		na
3-Methyl-1-butene	6.86E-06	NV		na	NA	NV		na
3-Methylhexane	9.62E-04	NV		na	NA	NV		na
3-Methylpentane	1.00E-03	NV		na	NA	NV		na
4-Methyl-1-pentene	5.15E-06	NV		na	NA	NV		na
6-Methyl-5-hepten-2-one	NA	NV		na	NA	NV		na
Acetic Acid	3.36E-04	NV		na	1.18E+00	3.68E+04	3.21E-05	no
Acetone	2.56E-04	3.65E+02	7.01E-07	no	8.96E-01	2.37E+06	3.78E-07	no
Acetonitrile	NA	6.21E+01		na	NA	1.01E+05		na
Acetophenone	NA	2.08E-02		na	NA	3.00E+04		na
Acetylene	1.21E-04	NV		na	NA	NV		na
Acrolein	1.30E-04	2.09E-02	6.24E-03	no	1.14E-01	2.30E+02	4.95E-04	no
Acrylonitrile	NA	2.83E-02		na	NA	2.20E+04		na
Allylchloride	NA	1.04E+00		na	NA	NV		na
alpha-Pinene	NA	NV		na	NA	NV		na
Benzaldehyde	6.82E-04	3.65E+02	1.87E-06	no	2.39E+00	1.50E+04	1.59E-04	no
Benzene	6.21E-04	2.49E-01	2.49E-03	no	1.27E+00	1.56E+05	8.13E-06	no
Benzene	6.52E-03	2.49E-01	2.62E-02	no	1.33E+01	1.56E+05	8.54E-05	no
Benzofuran	NA	NV		na	NA	NV		na
Benzonitrile	NA	NV		na	NA	1.50E+04		na
Benzylchloride	NA	3.96E-02		na	NA	NV		na
beta-Pinene	NA	NV		na	NA	NV		na
Butanal	NA	NV		na	NA	7.38E+04		na
Carbon Disulfide	1.36E-04	7.30E+02	1.86E-07	no	1.19E-01	3.10E+03	3.84E-05	no
Carbontetrachloride	NA	1.28E-01		na	NA	1.28E+05		na
Carbonyl Sulfide	3.80E-05	NV		na	1.33E-01	9.84E+03	1.35E-05	no
Chlorobenzene	NA	6.21E+01		na	NA	NV		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound (a)	**$C_{chronic}$ (µg/m³)**	**Health-Based Screening Level (µg/m³)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} (µg/m³)**	**Acute Toxicity Value (µg/m³)**	**C_{acute}/ ATV**	**> 1?**
Chloroethene	NA	2.24E-02		na	NA	NV		na
Chloroform	NA	8.35E-02		na	NA	2.48E+05		na
cis 1,3-Dichloro-1-propene	NA	5.17E-02		na	NA	NV		na
cis-2-Butene	8.58E-06	NV		na	NA	NV		na
cis-2-Hexene	5.15E-06	NV		na	NA	NV		na
cis-2-Pentene	6.87E-06	NV		na	NA	NV		na
cis-4-Methyl-2-pentene	NA	NV		na	NA	NV		na
Cyanogen	NA	NV		na	NA	NV		na
Cyclohexane	7.31E-04	NV		na	2.56E+00	3.10E+06	8.28E-07	no
Cyclohexanone	NA	1.83E+04		na	NA	NV		na
Cyclopentane	1.17E-04	NV		na	NA	NV		na
Cyclopentanone	NA	NV		na	NA	NV		na
Cyclopentene	6.01E-06	NV		na	NA	NV		na
Decanal	2.98E-04	NV		na	NA	NV		na
delta 3-Carene	NA	NV		na	NA	NV		na
Dichlorodifluoromethane	1.66E-05	2.09E+02	7.95E-08	no	5.81E-02	1.48E+07	3.92E-09	no
Dichlorotetrafluoroethane	NA	NV		na	NA	NV		na
Dimethyldisulfide	NA	NV		na	NA	NV		na
d-Limonene	NA	NV		na	NA	NV		na
ETBE	NA	NV		na	NA	NV		na
Ethane	NA	NV		na	NA	NV		na
Ethylbenzene	8.96E-04	1.06E+03	8.47E-07	no	3.14E+00	5.43E+05	5.79E-06	no
Ethylbenzene	1.47E-02	1.06E+03	1.39E-05	no	5.16E+01	5.43E+05	9.51E-05	no
Ethylchloride	NA	2.32E+00		na	NA	NV		na
Ethylcyclohexane	NA	NV		na	NA	NV		na
Ethylene	3.46E-04	NV		na	1.21E+00	4.60E+05	2.63E-06	no
Furan	NA	3.65E+00		na	NA	1.67E+02		na
Heptanal	9.10E-05	NV		na	NA	NV		na
Hexachlorobutadiene	NA	8.73E-02		na	NA	NV		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
Hexanal	NA	NV		na	NA	NV		na
Hexanenitrile	NA	NV		na	NA	NV		na
i-Butane	4.89E-05	NV		na	1.71E-01	9.52E+05	1.80E-07	no
i-Butene	1.00E-04	NV		na	3.52E-01	6.87E+06	5.12E-08	no
Indane	2.52E-03	NV		na	8.84E+00	1.25E+05	7.07E-05	no
i-Pentane	1.40E-03	NV		na	NA	NV		na
i-Propylbenzene	3.44E-05	4.02E+02	8.56E-08	no	NA	NV		na
Isoprene	1.72E-06	NV		na	NA	NV		na
m&p-Xylene	2.72E-02	7.30E+02	3.73E-05	no	9.54E+01	6.51E+05	1.47E-04	no
m-Dichlorobenzene	NA	3.29E+00		na	NA	NV		na
Methacrolein	NA	NV		na	NA	NV		na
Methyl Methacrylate	NA	7.30E+02		na	NA	NV		na
Methylbromide	NA	5.21E+00		na	NA	NV		na
Methylchloride	NA	1.07E+00		na	NA	NV		na
Methylchloroform	NA	1.04E+03		na	NA	1.94E+06		na
Methylcyclohexane	1.28E-03	3.13E+03	4.10E-07	no	4.50E+00	4.81E+06	9.34E-07	no
Methylcyclopentane	6.10E-04	NV		na	NA	NV		na
Methylenechloride	5.68E-05	4.09E+00	1.39E-05	no	1.16E-01	6.96E+05	1.67E-07	no
Methylnitrite	6.11E-04	NV		na	NA	NV		na
m-Ethyltoluene	3.58E-04	NV		na	NA	NV		na
Methyl-vinyl Ketone	NA	NV		na	NA	8.61E+01		na
MTBE	1.51E-03	3.13E+03	4.83E-07	no	5.29E+00	4.32E+05	1.23E-05	no
MTBE	1.57E-02	3.13E+03	5.02E-06	no	5.50E+01	4.32E+05	1.27E-04	no
m-Xylene & p-Xylene	2.42E-03	7.30E+02	3.32E-06	no	8.49E+00	6.51E+05	1.30E-05	no
Naphthalene	1.15E-03	3.13E+00	3.66E-04	no	4.02E+00	7.86E+04	5.11E-05	no
n-Butane	2.60E-04	NV		na	NA	NV		na
n-Decane	2.84E-05	NV		na	9.94E-02	4.37E+03	2.28E-05	no
n-Heptane	1.26E-03	NV		na	4.40E+00	1.80E+06	2.44E-06	no
n-Hexane	1.68E-03	2.09E+02	8.04E-06	no	5.88E+00	5.28E+05	1.11E-05	no

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound (a)	**$C_{chronic}$ (µg/m^3)**	**Health-Based Screening Level (µg/m^3)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} (µg/m^3)**	**Acute Toxicity Value (µg/m^3)**	**C_{acute}/ ATV**	**> 1?**
Nitromethane	8.70E-05	NV		na	3.05E-01	1.50E+05	2.03E-06	no
n-Nonane	1.07E-04	NV		na	3.73E-01	1.05E+06	3.56E-07	no
n-Octane	4.61E-04	NV		na	NA	NV		na
Nonanal	3.34E-04	NV		na	NA	NV		na
n-Pentane	1.42E-03	NV		na	4.99E+00	1.80E+06	2.77E-06	no
n-Propylbenzene	1.96E-04	3.65E+01	5.37E-06	no	6.87E-01	3.68E+05	1.86E-06	no
Octanal	2.47E-04	NV		na	NA	NV		na
o-Dichlorobenzene	NA	2.09E+02		na	NA	NV		na
o-Ethyltoluene	2.30E-04	NV		na	8.07E-01	7.50E+02	1.08E-03	no
o-Xylene	1.54E-03	7.30E+02	2.11E-06	no	5.40E+00	6.51E+05	8.29E-06	no
o-Xylene	1.71E-02	7.30E+02	2.34E-05	no	5.99E+01	6.51E+05	9.20E-05	no
p-Dichlorobenzene	NA	2.80E-01		na	NA	NV		na
Pentanal	NA	NV		na	NA	NV		na
Pentanenitrile	NA	NV		na	NA	NV		na
Perchloroethylene	3.60E-04	3.31E+00	1.09E-04	no	7.35E-01	6.89E+05	1.07E-06	no
p-Ethyltoluene	7.87E-04	NV		na	2.76E+00	1.25E+05	2.21E-05	no
p-Ethyltoluene	5.98E-03	NV		na	2.10E+01	1.25E+05	1.68E-04	no
Phenylacetylene	NA	NV		na	NA	NV		na
Propane	0.00E+00	NV		na	0.00E+00	3.78E+06	0.00E+00	no
Propanenitrile	NA	NV		na	NA	3.38E+04		na
Propene	1.58E-04	NV		na	NA	NV		na
Styrene	2.58E-05	1.06E+03	2.43E-08	no	2.26E-02	2.13E+05	1.06E-07	no
Styrene	2.12E-04	1.06E+03	2.01E-07	no	1.86E-01	2.13E+05	8.73E-07	no
Tetrahydrofuran	NA	9.89E-01		na	NA	NV		na
Thiophene	NA	NV		na	NA	NV		na
Toluene	3.50E-03	4.02E+02	8.71E-06	no	3.06E+00	1.88E+05	1.63E-05	no
Toluene	3.85E-02	4.02E+02	9.60E-05	no	3.37E+01	1.88E+05	1.80E-04	no
trans 1,3-Dichloro-1-propene	NA	NV		na	NA	NV		na
trans-2-Butenal	NA	3.54E-03		na	NA	NV		na

Table D-2: Comparison of Air Concentrations With Health-Based Values: Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound (a)	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
trans-2-Butene	2.75E-05	NV		na	NA	NV		na
trans-2-Hexene	9.45E-06	NV		na	NA	NV		na
trans-2-Pentene	1.29E-05	NV		na	NA	NV		na
Trichloroethylene	NA	1.12E+00		na	NA	NV		na
Trichloromonofluoromethane	NA	7.30E+02		na	NA	NV		na
Vinylidenechloride	NA	3.84E-02		na	NA	NV		na

Footnotes:

(a) Items in bold represent duplicate values for those compounds that are common for Method TO-14 and TO-12.

NA = Not applicable

na = Not available because health-based screening value is not available or not applicable because compound was not detected.

NV = No value

$C_{chronic}$ = Chronic time-averaged concentration

HBSL = Chronic health-based screening level

C_{acute} = Acute concentration

ATV = Acute toxicity value

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
1,2,4,5-Tetrachlorobenzene	NA	1.10E+00		na	NA	NV		na
1,2,4-Trichlorobenzene	NA	2.08E+02		na	NA	NV		na
1,2-Dichlorobenzene	NA	2.09E+02		na	NA	NV		na
1,3-Dichlorobenzene	NA	3.29E+00		na	NA	NV		na
1,3-Dinitrobenzene	NA	3.65E-01		na	NA	NV		na
1,4-Dichlorobenzene	NA	3.06E-01		na	NA	NV		na
1,4-Naphthoquinone	NA	NV		na	NA	NV		na
1-Naphthylamine	NA	NV		na	NA	NV		na
2,3,4,6-Tetrachlorophenol	NA	1.10E+02		na	NA	NV		na
2,4,5-Trichlorophenol	NA	3.65E+02		na	NA	NV		na
2,4,6-Trichlorophenol	NA	6.20E-01		na	NA	NV		na
2,4-Dichlorophenol	NA	1.10E+01		na	NA	NV		na
2,4-Dimethylphenol	NA	7.30E+01		na	NA	NV		na
2,4-Dinitrophenol	NA	7.30E+00		na	NA	NV		na
2,4-Dinitrotoluene	NA	7.30E+00		na	NA	NV		na
2,6-Dichlorophenol	NA	NV		na	NA	NV		na
2,6-Dinitrotoluene	NA	3.65E+00		na	NA	NV		na
2-Acetylaminofluorene	NA	NV		na	NA	NV		na
2-Chloronaphthalene	NA	2.92E+02		na	NA	NV		na
2-Chlorophenol	NA	1.83E+01		na	NA	NV		na
2-Methylnaphthalene	2.07E-04	7.30E+01	2.83E-06	no	7.25E-01	2.00E+04	3.62E-05	no
2-Methylphenol	NA	1.83E+02		na	NA	NV		na
2-Naphthylamine	NA	NV		na	NA	NV		na
2-Nitroaniline	NA	2.09E-01		na	NA	NV		na
2-Nitrophenol	NA	NV		na	NA	NV		na
2-Picoline	NA	NV		na	NA	NV		na
3,3'-Dichlorobenzidine	NA	1.49E-02		na	NA	NV		na
3,3'-Dimethylbenzidine	NA	7.31E-04		na	NA	NV		na
3-Methylcholanthrene	NA	NV		na	NA	NV		na
3-Nitroaniline	NA	NV		na	NA	NV		na
4,6-Dinitro-2-methylphenol	NA	3.65E-01		na	NA	NV		na

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
4-Aminobiphenyl	NA	NV		na	NA	NV		na
4-Bromophenylphenyl ether	NA	NV		na	NA	NV		na
4-Chloro-3-methylphenol	NA	NV		na	NA	NV		na
4-Chlorophenylphenyl ether	NA	NV		na	NA	NV		na
4-Methylphenol/3-Methylphenol	9.14E-06	1.83E+01	5.01E-07	no	NA	NV		na
4-Nitroaniline	NA	NV		na	NA	NV		na
4-Nitrophenol	NA	2.92E+01		na	NA	NV		na
4-Nitroquinoline-1-oxide	NA	NV		na	NA	NV		na
5-Nitro-o-toluidine	NA	NV		na	NA	NV		na
7,12-Dimethylbenz(a)anthracene	NA	NV		na	NA	NV		na
Acenaphthene	NA	2.19E+02		na	NA	NV		na
Acenaphthylene	9.89E-06	NV		na	3.47E-02	2.00E+02	1.73E-04	no
Acetophenone	NA	2.08E-02		na	NA	3.00E+04		na
Aniline	NA	1.04E+00		na	NA	2.29E+04		na
Anthracene	NA	1.10E+03		na	NA	NV		na
Benz(a)anthracene	NA	2.17E-02		na	NA	NV		na
Benz(a)pyrene	NA	2.17E-03		na	NA	NV		na
Benzidine	NA	2.92E-05		na	NA	NV		na
Benzo(b)fluoranthene	NA	2.17E-02		na	NA	NV		na
Benzo(g,h,i)perylene	NA	NV		na	NA	NV		na
Benzo(k)fluoranthene	NA	2.17E-01		na	NA	NV		na
Benzoic acid	NA	1.46E+04		na	NA	NV		na
Benzyl alcohol	1.00E-05	1.10E+03	9.17E-09	no	3.52E-02	5.53E+04	6.37E-07	no
bis(2-Chloroethoxy)methane	NA	NV		na	NA	NV		na
bis(2-Chloroethyl)ether	NA	5.82E-03		na	NA	NV		na
bis(2-Chloroisopropyl)ether	NA	1.92E-01		na	NA	NV		na
bis(2-Ethylhexyl)phthalate	NA	4.80E-01		na	NA	NV		na
Butylbenzylphthalate	NA	7.30E+02		na	NA	5.00E+05		na
Carbazole	NA	3.36E-01		na	NA	NV		na
Chlorobenzilate	NA	2.49E-02		na	NA	NV		na
Chrysene	NA	2.17E+00		na	NA	NV		na

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
Diallate	NA	1.10E-01		na	NA	NV		na
Dibenz(a,h)anthracene	NA	2.17E-03		na	NA	NV		na
Dibenzofuran	NA	1.46E+01		na	NA	NV		na
Diethylphthalate	NA	2.92E+03		na	NA	1.50E+04		na
Dimethylphenethylamine	NA	3.65E+00		na	NA	NV		na
Dimethylphthalate	NA	3.65E+04		na	NA	NV		na
Di-n-butylphthalate	NA	3.65E+02		na	NA	1.50E+04		na
Di-n-octylphthalate	NA	7.30E+01		na	NA	1.50E+05		na
Diphenylamine/N-NitrosoDPA	NA	9.13E+01		na	NA	NV		na
Ethyl methanesulfonate	NA	NV		na	NA	NV		na
Fluoranthene	NA	1.46E+02		na	NA	NV		na
Fluorene	1.94E-06	1.46E+02	1.33E-08	no	6.81E-03	7.50E+04	9.08E-08	no
Hexachlorobenzene	NA	4.18E-03		na	NA	NV		na
Hexachlorobutadiene	NA	8.62E-02		na	NA	NV		na
Hexachlorocyclopentadiene	NA	7.30E-02		na	NA	NV		na
Hexachloroethane	NA	4.80E-01		na	NA	NV		na
Hexachloropropene	NA	NV		na	NA	NV		na
Indeno(1,2,3-cd)pyrene	NA	2.17E-02		na	NA	NV		na
Isophorone	NA	7.08E+00		na	NA	NV		na
Isosafrole	NA	NV		na	NA	NV		na
Kepone	NA	3.74E-04		na	NA	NV		na
Methapyrilene	NA	NV		na	NA	NV		na
Methyl methanesulfonate	NA	NV		na	NA	NV		na
Naphthalene	4.81E-04	3.13E+00	1.54E-04	no	1.68E+00	7.86E+04	2.14E-05	no
Nitrobenzene	NA	2.09E+00		na	NA	NV		na
N-Nitrosodiethylamine	NA	4.47E-05		na	NA	NV		na
N-Nitrosodimethylamine	NA	4.47E-05		na	NA	NV		na
N-Nitroso-di-n-butylamine	NA	1.20E-03		na	NA	NV		na
N-Nitroso-di-n-propylamine	NA	9.61E-04		na	NA	NV		na
N-Nitrosomethylethylamine	NA	3.06E-04		na	NA	NV		na
N-Nitrosomorpholine	NA	NV		na	NA	NV		na

Table D-3: Comparison of Air Concentrations With Health-Based Values: Semi-Volatile Organic Compounds

	M110 FLASH ARTILLERY SIMULATOR							
Compound	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
N-Nitrosopiperidine	NA	NV		na	NA	NV		na
N-Nitrosopyrrolidine	NA	3.15E-03		na	NA	NV		na
o-Toluidine	NA	2.80E-02		na	NA	NV		na
p-Chloroaniline	NA	1.46E+01		na	NA	NV		na
p-Dimethylaminoazobenzene	NA	NV		na	NA	NV		na
Pentachlorobenzene	NA	2.92E+00		na	NA	NV		na
Pentachloroethane	NA	NV		na	NA	NV		na
Pentachloronitrobenzene	NA	2.59E-02		na	NA	NV		na
Pentachlorophenol	NA	5.60E-02		na	NA	NV		na
Phenacetin	NA	NV		na	NA	NV		na
Phenanthrene	5.77E-06	NV		na	2.02E-02	2.00E+03	1.01E-05	no
Phenol	NA	2.19E+03		na	NA	NV		na
Pronamide	NA	2.74E+02		na	NA	NV		na
Pyrene	NA	NV		na	NA	NV		na
Pyridine	NA	3.65E+00		na	NA	NV		na
Safrole	NA	NV		na	NA	NV		na
sym-Trinitrobenzene	NA	1.10E+02		na	NA	NV		na

Footnotes:
NA = Not applicable
na = Not available because health-based screening value is not available or not applicable because compound was not detected.
NV = No value
$C_{chronic}$ = Chronic time-averaged concentration
HBSL = Chronic health-based screening level
C_{acute} = Acute concentration
ATV = Acute toxicity value

Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons

	M110 Flash Artillery Simulator			
Compound (a)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)
	Aliphatic:C<=8	*Aliphatic:C>8*	*Aromatic:C<=8*	*Aromatic:C>8*
1,2,4-Trimethylbenzene	NA	NA	NA	1.13E-02
1,2,4-Trimethylbenzene & sec-Butylbenzene	NA	NA	NA	1.19E-03
1-Butene	3.86E-05	NA	NA	NA
1-Hexene	6.89E-06	NA	NA	NA
1-Pentene	1.37E-05	NA	NA	NA
2,2,4-Trimethylhexane	NA	2.66E-05	NA	NA
2,2,4-Trimethylpentane	2.43E-04	NA	NA	NA
2,2-Dimethylbutane	1.25E-04	NA	NA	NA
2,3,4-Trimethylpentane	4.21E-05	NA	NA	NA
2,3-Dimethylbutane	2.78E-04	NA	NA	NA
2,3-Dimethylhexane	7.39E-05	NA	NA	NA
2,3-Dimethylpentane	2.67E-04	NA	NA	NA
2,4-Dimethylhexane	1.49E-04	NA	NA	NA
2,4-Dimethylpentane	1.63E-04	NA	NA	NA
2,5-Dimethylhexane	1.28E-04	NA	NA	NA
2-Methyl-1-butene	1.98E-05	NA	NA	NA
2-Methyl-1-pentene	1.21E-05	NA	NA	NA
2-Methyl-2-butene	7.72E-06	NA	NA	NA
2-Methyl-2-pentene	7.72E-06	NA	NA	NA
2-Methylheptane	4.06E-04	NA	NA	NA
2-Methylhexane	8.86E-04	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	1.60E-04
2-Methylpentane	1.42E-03	NA	NA	NA
3-Methyl-1-butene	6.86E-06	NA	NA	NA
3-Methylhexane	9.62E-04	NA	NA	NA
3-Methylpentane	1.00E-03	NA	NA	NA

Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons

	M110 Flash Artillery Simulator			
Compound (a)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)
	Aliphatic:C<=8	*Aliphatic:C>8*	*Aromatic:C<=8*	*Aromatic:C>8*
4-Methyl-1-pentene	5.15E-06	NA	NA	NA
Benzene	NA	NA	1.45E-03	NA
Benzene	NA	NA	1.52E-02	NA
cis-2-Butene	8.58E-06	NA	NA	NA
cis-2-Hexene	5.15E-06	NA	NA	NA
cis-2-Pentene	6.87E-06	NA	NA	NA
Cyclohexane	7.31E-04	NA	NA	NA
Cyclopentane	1.17E-04	NA	NA	NA
Cyclopentene	6.01E-06	NA	NA	NA
Ethylbenzene	NA	NA	8.96E-04	NA
Ethylbenzene	NA	NA	1.47E-02	NA
i-Butane	4.89E-05	NA	NA	NA
i-Butene	1.00E-04	NA	NA	NA
Indane	NA	NA	NA	2.52E-03
i-Pentane	1.40E-03	NA	NA	NA
i-Propylbenzene	NA	NA	NA	3.44E-05
m&p-Xylene	NA	NA	2.72E-02	NA
Methylcyclohexane	1.28E-03	NA	NA	NA
Methylcyclopentane	6.10E-04	NA	NA	NA
m-Xylene & p-Xylene	NA	NA	2.42E-03	NA
n-Butane	2.60E-04	NA	NA	NA
n-Decane	NA	2.84E-05	NA	NA
n-Heptane	1.26E-03	NA	NA	NA
n-Hexane	1.68E-03	NA	NA	NA
n-Nonane	NA	1.07E-04	NA	NA
n-Octane	4.61E-04	NA	NA	NA

Table D-4: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons

Compound (a)	M110 Flash Artillery Simulator			
	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)
	Aliphatic:C<=8	***Aliphatic:C>8***	***Aromatic:C<=8***	***Aromatic:C>8***
n-Pentane	1.42E-03	NA	NA	NA
n-Propylbenzene	NA	NA	NA	1.96E-04
o-Xylene	NA	NA	1.54E-03	NA
o-Xylene	NA	NA	1.71E-02	NA
Propane	0.00E+00	NA	NA	NA
Styrene	NA	NA	NA	2.58E-05
Styrene	NA	NA	NA	2.12E-04
Toluene	NA	NA	3.50E-03	NA
Toluene	NA	NA	3.85E-02	NA
trans-2-Butene	2.75E-05	NA	NA	NA
trans-2-Hexene	9.45E-06	NA	NA	NA
trans-2-Pentene	1.29E-05	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	2.07E-04
Acenaphthylene	NA	NA	NA	9.89E-06
Total (µg/m^3)	1.56E-02	1.62E-04	1.13E-01	1.44E-02
Derived Health-Based Screening Level	1.92E+04	1.04E+03	4.17E+02	2.09E+02
$C_{chronic}$/HBSL	8.12E-07	1.55E-07	2.70E-04	6.92E-05
>1?	no	no	no	no

Footnotes:
(a) Items in bold represent duplicate values: highest concentration was used to estimate total petroleum hydrocarbon concentration
>1? = Is the ratio greater than one?
NA = Not Applicable because compound was not detected
$C_{chronic}$ = chronic averaged air Concentration
HBSL = Health-Based Screening Level

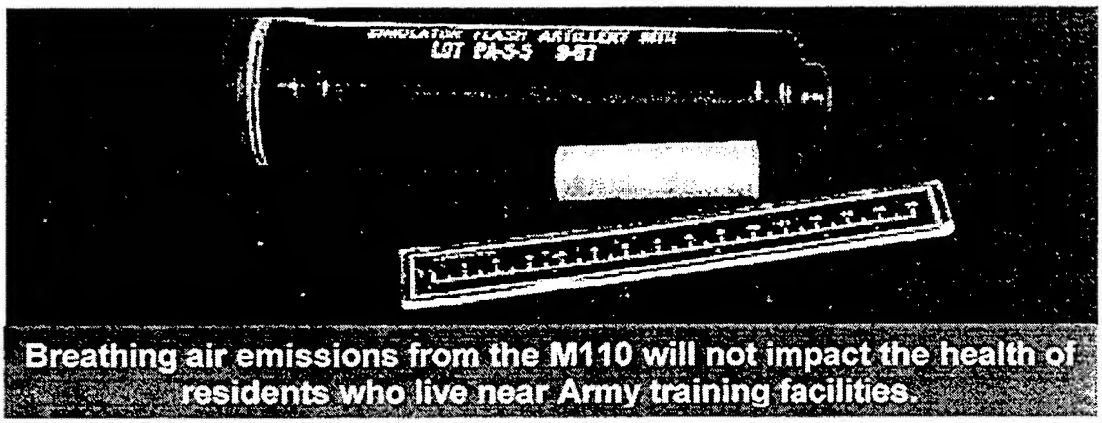
APPENDIX E

FACT SHEET SUBMITTED TO AEC

United States Army Environmental Center
Pyrotechnics Fact Sheet

M110 Flash Artillery Simulator

Department of Defense Identification Code: L596



Breathing air emissions from the M110 will not impact the health of residents who live near Army training facilities.

WHAT ARE PYROTECHNICS?

The terms pyrotechnics and fireworks are often used interchangeably. Pyrotechnics give off smoke, light, and/or a loud noise when activated. The military uses pyrotechnics for signaling, obscuring, and illuminating during training and combat.

WHAT IS THE M110?

The M110 Flash Artillery or "gunflash" is one kind of pyrotechnics that is used to mimic gun flashes. Since it is used to imitate the sounds and flashes of combat, it is a simulator.

The M110 is approximately 8 inches long and 2 inches wide. When loaded, it contains about 3 ounces of explosive charge and weighs about 1 pound.

HOW IS THE M110 USED?

The M110 is used as a "blank" during training exercises in place of actual weapons. It produces a flash that is similar to the 90 mm Gun M2 series and the 155 mm Howitzer M1 series. The item is activated at a safe distance (at least 50 yards) by wires connected to an electric source. When activated, it produces a flash and a bang almost as loud as the actual weapon. This simulation is very important in training exercises because it allows our service men and women to prepare for real life situations.

WHERE IS THE M110 USED?

Many Army training events use the M110. These events are held at nearly every Army training installation. At most locations, the training areas are at least 1000 meters (over half a mile) away from populated areas. Typically, ten items are activated during an entire day of training, which generally occurs five times a year.

WHAT IS IN THE M110?

To simulate gun flashes, the M110 contains a pyrotechnic charge referred

to as the flash composition. This composition is made up mostly of magnesium powder and potassium perchlorate. The M110 also contains gasoline that is added prior to the item's use.

WILL BREATHING AIR EMISSIONS FROM THE M110 AFFECT MY HEALTH?

To answer this question, the U.S. Army Environmental Center tested the air emissions from the M110. The U.S. Army Center for Health Promotion and Preventive Medicine then determined if there would be a potential for health effects from inhalation to residents living near training areas. Study results showed that residents breathing air as close as 100 meters (328 feet) from the activation point are safe from these emissions.

HOW WAS THE STUDY DONE?

To gather data for the study, airborne emissions data was collected by activating the M110 in a test chamber. The air in the chamber was tested to identify the types and amounts of substances released. More than 300 substances were looked for during this part of the study.

This information was then used in an air model (a computer program that allows estimation of air concentrations) to determine the amount of each substance, to which someone living near a training site might be exposed. Downwind concentrations were estimated based on a typical use scenario for the M110. Since the study does not look at a specific training area, generic assumptions were used to model the path of the emissions.

These estimated air concentrations were then compared to safe screening levels established by the U.S. Environmental Protection Agency and other agencies. If the air concentrations are below these screening levels, they are considered safe for everyone, including sensitive people such as the sick, elderly, and children.

WHAT ARE THE LIMITATIONS OF THIS STUDY?

Many steps were taken to ensure that the results of this study are protective of everyone who lives close to training areas. However, limitations do exist with this study. For example, the study does not consider exposure to other types of pyrotechnics that could also be used during the same training event. Due to these limitations, conservative assumptions were used to ensure the protection of public health from inhalation of the M110 air emissions.

WHERE CAN I GET MORE INFORMATION?

Additional information about the M110 or other military munitions can be obtained by calling the Army Environmental Center Hotline at 1-800-USA-3845 or email to t2hotline@aec.apgea. army.mil. Please also visit our website at www.aec.army.mil